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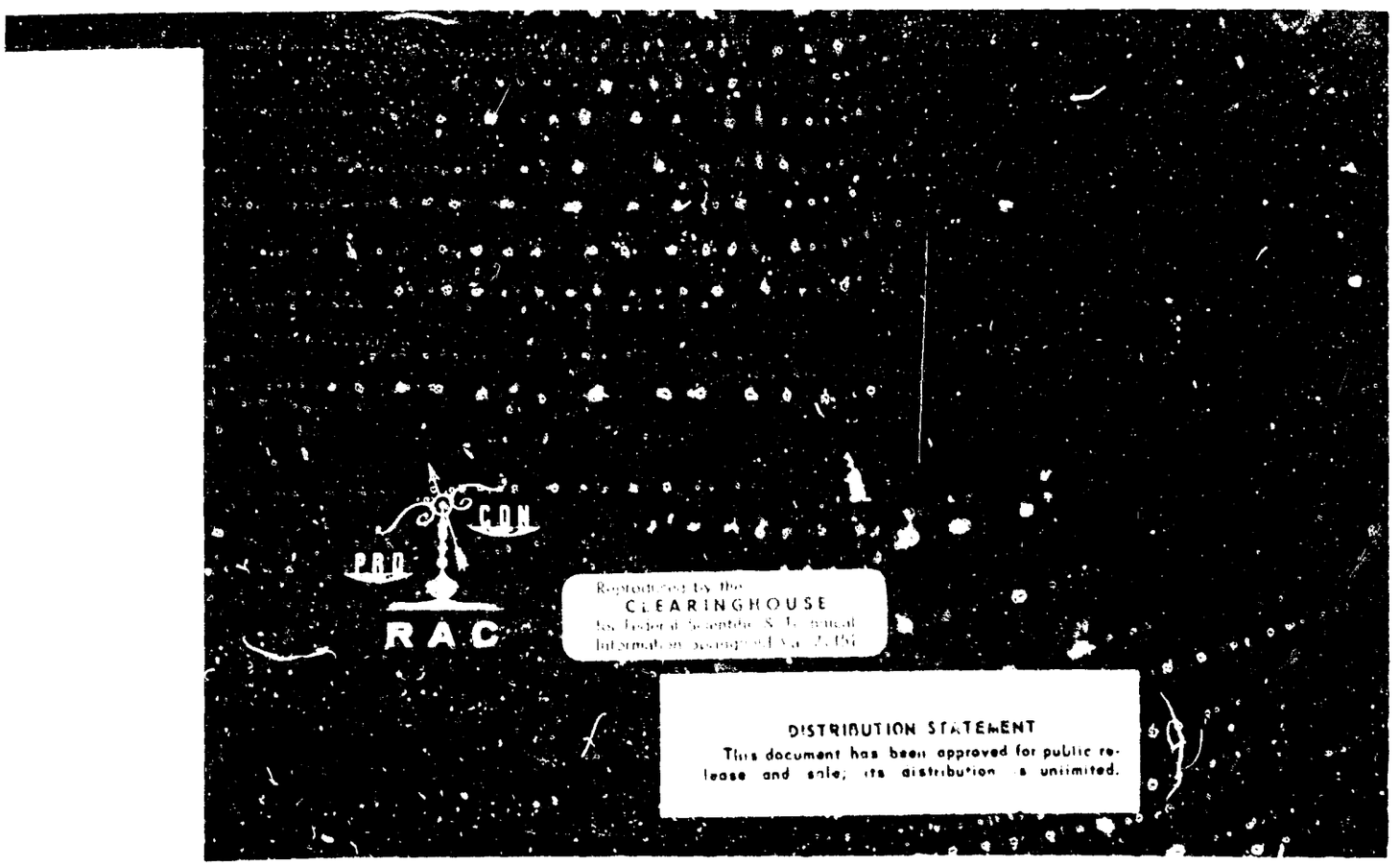
Four Papers on Problems of Strategy



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Four Papers on Problems of Strategy

by
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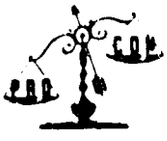

RESEARCH ANALYSIS CORPORATION

MCLEAN, VIRGINIA

PREFACE

The four papers ~~presented here~~ are quite different in their topics. Each one, however, examines a situation that is important for strategic considerations in this decade, and on each of these situations some confusion and divergence in thinking has been evident. Also, each of the four papers treats the facts, and the change or development of the facts, as one aspect of the situation, and the prevailing set or sets of ideas about the situation, and the growth and change of such ideas, as another aspect. Each paper then tries to show that the imperfect lock on as between ideas and facts permits ideas to drift, or to stand still while facts change.

The first two papers are related to nuclear warfare, one with specific reference to the industrial effort that must underlie nuclear military power; and the second with the implications of such nuclear military power at the lower end of its spectrum, i.e., in connection with tactical nuclear warfare and the paired concepts of deterrence and escalation. The last two papers are both concerned with the evolution or development of the character of politics as it reflects the development of knowledge of scientific or technological character, on the one hand, and, specifically, of political knowledge on the other. All four share the emphasis on change over time, and on the hiatus between the development of changes in the facts on the one hand and changes in derivative systems of thought or theory on the other.

Each of the papers is a little dated. Arrangements for their open publication involved varying delays. An effort to bring them up-to-date in data was considered. However, the significant point of any one of them would not be affected in any essential. Hence in all but a few details, and with some cutting, they have been left in their original forms.

It is felt that they may have some value to a few readers outside the closed community of Government agencies, and it is for that reason that they are made available in this manner.

George S. Pettee
Chairman, Research Council

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PREFACE

This paper examines the structure and size of the industrial effort involved in producing nuclear materials for military weapons and other purposes. The data presented and interpreted are entirely from unclassified publications available to anyone who cares to study the subject. It is also entirely concerned with the US. Mr. Oscar W. Torreson did a substantial part of the work in collecting the data for this paper.

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INTRODUCTION

The writings on nuclear weapons and nuclear warfare presented to the public since 1945 have been voluminous. They have covered the basic physics with great clarity, especially in the excellent account given in, first, the "Smyth Report."[1] The strategic implications and consequences of any full-scale nuclear war have been examined and analyzed with vigor and sophistication. The literature has blown up into a mass that can stupefy with its technical controversies, its elaboration of varied consequences from varied assumptions, and the growing tendency of the cognoscenti to quote each other in a manner that says to the layman, "If you wish to understand my book you must read 100 others."

Withal, there has been one omission; little or nothing has been said clearly that gives a sense of scale as to quantities of materials and weapons. One can trace the lack from the starting point, the closely held secrecy as to the size of "stockpiles." One can find it, however, also in some of the effects on the argument. Quite learned men, assuming that the quantities are unknown and unknowable, tend occasionally to draw conclusions that simply would not be suggested if quantities were known. Thus the tendency of writers, including very prominent ones, to speak as if any nuclear power is one nuclear power, without regard to quantity, or as if any nation having one or more atomic or nuclear bombs can enter adversary negotiations with any other as an equal. But atomic stockpiles are no more equal than navies are or used to be. Quantities do matter, and quantities can be increased only by going through a series of laborious and costly steps that take time and effort.

What the paper tries to show is simply how much of the picture can be made clear by assembling and sorting out a rather small quantity of available information. The object is not to arrive at exact quantities but only to establish a general sense of scale and its significance.

GENERAL SCALE OF THE US NUCLEAR INDUSTRY

A fairly definite impression of the scale of the US nuclear industry is indicated by the following data:

The procurement of uranium concentrates has now (as of the time of this writing) reached a total of approximately 200,000 short tons (Stons), with 97,000 additional tons under future commitment. The concentrates are U_3O_8 containing 84.8 percent uranium, of which 0.721 percent is uranium 235. The U^{235} contained in 200,000 Stons of uranium concentrates therefore would be about 1100 metric tons (MT). In the process of separation, a small fraction of uranium enriched in U^{235} is produced, and a vastly larger fraction of uranium depleted of the isotope. Depletion from the natural level of 0.721 percent to 0.38 percent and to 0.22

percent (and to intermediate levels) is indicated in Atomic Energy Commission (AEC) published information (Ref 2, p 26).

The cost of operation of the AEC devoted mainly to weapons production for the past 11 years has been $5.3 billion for procurement of raw materials, $6.6 billion for the production of nuclear materials, and $4.3 billion for weapons development and fabrication, or 28.5 percent, 43.5 percent, and 28 percent, respectively, for the total of the three items.

The production of uranium is not the whole of the nuclear industry; plutonium, heavy hydrogen, thorium, and other materials are also involved. The economic scale for these other items can only be suggested and this by reference to data on plant investment costs, which now stand at $1.6 billion for production reactors and separation areas, and $260 million for heavy water, which may be compared to $2.3 billion for uranium separation plants.

The total US investment in the nuclear industry and its products now stands at approximately $29 billion.

Some of the above items deserve further explanatory comment.

The uranium concentrates procured were almost entirely from sources outside the US before 1950, and continued to be predominantly from foreign sources until about 1956. The first year in which domestic procurement exceeded foreign procurement was 1961. (Data on uranium ore and on concentrates of U_3O_8 are given in all the sources in short tons, while data for later processing stages are given in metric measurement. The reader who wishes to clarify this may find Table 4 in the appendix of some assistance.)

The US purchases of uranium oxide did not reach a total of 100,000 Stons until 1959. However, they reached 200,000 Stons during 1962 and will presumably reach 300,000 Stons within another 5 or 6 years (cumulative).

The electric power used in the diffusion separation plants is a major feature of the requirements of the industry. The AEC report for July–December 1956 (Ref 3, p 389) states, with reference to the three gaseous diffusion plants, that

> Consumption of electric power in these plants amounts to approximately one-tenth of the electric power produced by all the electric utility companies in the United States.

According to Federal Power Commission data the production of power by the public service power industry in 1956 was 600 billion kwh (excluding "captive" plants). Therefore, approximately one-tenth would equal approximately 60 billion kwh.

As an added comment, the procurement of concentrates reached only 10,440 Stons in 1956, but increased to 16,159 in the following year, and has been more than 35,000 Stons in each year since then. It is implied that the input either could not have reached the full capacity of the plants in 1956, or only during the last part of 1956, or that procurement of concentrates has exceeded the annual throughput rate, with consequent stocking of a reserve. If the throughput increased substantially after 1956, then the consumption of power may have increased also; otherwise there must have been corresponding improvements in the efficiency of the process. However, the lone and perhaps imprecise figure of 60 billion kwh appears firm for its time period, though approximate, and this in turn permits some further observations.

The cost was stated as approximately 4 mils per kwh for a total of about $240 million.

The capacity required would have been about 8.5 million kw, at 7000 kwh/year/kw installed.

The cost of plants was at the time about $115 per kw installed, and for 8.5 million kw, the cost would be about $1 billion.

Coal required, at 0.95 lb/kwh would be about 28 million Stons per year.

This invites comparison with worldwide power statistics. In 1961 only eight nations had as much electric power production per year as was consumed by the US diffusion plants at the late 1956 rate.[1] This is shown in the accompanying tabulation.

Nation	Electric power (billions of kwh)
US	879
USSR	310
Great Britain	138
Japan	125
W. Germany	116
Canada	113
France	74
Italy	60

Only five more countries had as much as 29 billion kwh production in 1961, of which mainland China had an estimated 29 billion kwh.

The amount of uranium devoted to peaceful purposes rather than to military purposes appears to have been small. AEC shipments during 1962 (Ref 2, p 218) amounted to 196,000 lb of enriched uranium hexafluoride at a value of $29 million, which in terms of the price list (Ref 2, p 26) corresponds to an enrichment level of 5 percent uranium 235. This indicates a content of 3000 kg of U^{235}.

Depletion of natural uranium from 0.721 percent to a content of 0.38 percent U^{235} leaves almost 52.7 percent of the initial content in the depleted portion, with 47.3 percent in the enriched portion. On the other hand, depletion to 0.0022 U^{235} would leave only 30.5 percent in the depleted portion and 69.5 in the enriched portion. Thus, if a quantity of uranium containing 1000 units of U^{235} were fully processed, the enriched fraction might contain between 470 and 695 units of U^{235} and the depleted fraction might contain between 527 and 305 units. The weight of the enriched portion, even if enriched to a very high level, would of course be greater by some amount than the weight of the U^{235} contained.

It may be noted that, given a specified enrichment level, even of exact accuracy, there is no means to determine the exact proportions of the enriched to the depleted, or simply, what fraction of initial content of the desired material is recovered. However, given a very low level of initial content and a very high though only approximate specified level of enrichment of most of the enriched portion, then any specified level of depletion serves to determine, within only a small error, the amounts recovered and not recovered.

STRUCTURE OF INDUSTRY

The main structural phases of the industry, as pertains to uranium, are indicated in Table 4. It is apparent that the industry proceeds through a rather elaborate series of stages that enormously reduce the quantity of material in process, at great cost, to obtain the essentially useful uranium, highly enriched in U^{235}.

During the 20-year life of the industry a number of problems had to be surmounted that no longer create any difficulty but should be included in a full description.

One of the first great problems was to find sufficient sources of uranium ore. As the AEC Report for 1947–1948 stated:

> The raw materials situation faced by the Nation in early 1947, . . . when the Commission became responsible for the program was as follows:
>
> The vital atomic energy enterprise was largely dependent upon remote sources of uranium; only insignificant amounts of byproduct uranium were being obtained domestically.
>
> Known domestic sources were principally in the form of low grade material, and economical methods of extracting uranium had to be developed [Ref 5, p 6].

In contrast, known reserves at the end of 1962 were rated as 68 million Stons of ore, and the prospecting effort has ceased.

The process of extracting U_3O_8 from low-grade ores has been very much improved, and this interacts with the rated quantity of ore reserves, since the grade of ore worth counting must be the same as the grade worth working. The extraction process represents a considerable "value added," as is reflected in the difference between the value of the ore delivered to the mill and the value of the concentrates delivered from the mill (see Table 4).

Uranium oxide must be changed into uranium hexafluoride at a very high purity before it becomes "feed material" for the great diffusion plants. This stage of the industry required process advances for the production of large quantities of very pure fluorine and for other processes. The whole process has continued to advance sufficiently so that some of the feed-material plants have been closed down (Ref 6, p 218). The total uranium content in the feed materials produced is only negligibly lower than the uranium content of the uranium oxide utilized.

The separation of isotopes is the largest single operation. After examining all methods the US committed itself to the gaseous diffusion process and built one great plant for this purpose at Oak Ridge, Tenn., during WWII and two more major plants at Paducah, Ky., and Portsmouth, Ohio, which came into operation in 1956. The total cost of these three plants stands at about $2.3 billion, and as noted earlier their electric power consumption apparently reached the neighborhood of 60 billion kwh/year in 1956.

The diffusion process, utilizing filters, works through several thousand stages in what is termed a "cascade." The technology is highly secret. The best short and unclassified description found is in the AEC report for 1947–1948 (Ref 5, p 15).

K-25, The Gaseous Diffusion Plant

K-25, the gaseous diffusion plant at Oak Ridge, Tenn., consists essentially of thousands of . . . barriers, through which uranium hexafluoride gas is continuously cycled, recycled, and finally drawn off when it reaches a certain stage of enrichment in the U-235 isotope. This process requires thousands of miles of pipe, thousands of pumps and motors, and myriads of intricate electrical and electronic mechanisms for control of the whole complex process. Because uranium hexafluoride is intensely corrosive, the entire system must be leakproof and corrosion-proof. K-25 is the largest continuous process plant in the world under a single roof—a 60-acre roof. The plant is approximately 1 mile long, a twelfth of a mile wide, four stories high, and U-shaped. K-27, a companion process building is approximately one-fourth as large. The accompanying steam power plant is the largest plant of its kind ever constructed at one time. . . .

The contract operator for K-25 is the Carbide and Carbon Chemical Corporation. During the last 2 years the men of this company have worked persistently and effectively to increase the yield of precious U-235 and to lower the cost of operation. The year 1948 has seen considerable progress toward these goals . . . .

". . . the total area of barrier used in the plant is measured in square miles."

The engineers and scientists who developed the first barriers in haste during the war achieved remarkable success, but of course much room remained for improvement. . . . Barrier manufacture since its inception has been a "batch-type" operation; recent developments, however, have pointed the way toward a more efficient process for continuous production of barriers. Efficiency of production of U-235 would be greatly increased by this change. Meanwhile, certain of the originally installed barriers are being replaced by higher quality material and a substantial increase in production yield is expected from this step.[5]

One important characteristic of the diffusion plants is the quantity of material in process. The "Smyth Report,"[1] in 1945, discussed this and mentions that it is very large.

The total amount of material tied up in a separation plant is called the "hold-up." The hold-up may be very large in a plant consisting of many stages. [Ref 1, p 157]

No clear indication of its amount has been published so far as noted, but indirect indications are that it may amount to something in the range of 1 to 3 times as much as 1 year's input.

Plant depreciation is one more feature of the structure of the industry that has economic interest. The AEC has not published very much information on this, and the most important single statement found is only in the form of a graph. This graph (Ref 2, p 589) indicates somewhat over $2 billion accumulated depreciation as of 1962 with no breakdown among types of plants. Taken literally, this would imply that the total cost of AEC plant and equipment to date has been about $2 billion larger than the current figures for investment in plant and equipment.

The outstanding alternative to the gaseous diffusion process is the centrifuge process. Technical advances in the design of centrifuges have attracted public attention in recent years. It appears that the centrifuge process could be used, with a lower cost in electric power for the quantity processed, but only at considerably greater expense for the plant required. The best unclassified statement found on this subject is in the AEC report of January 1961 (Ref 7, pp 500–04). The gist is given in the following excerpts:

Two possible advantages of the gas centrifuge method, as compared with the gaseous diffusion process we now use for uranium isotope separation, are the potential lower requirement of a centrifuge plant for electric power and its potential requirement for fewer

units in series in order to produce the desired enrichment of U-235. Further, it appears to be particularly well suited for low-capacity installations. [Ref 7, p 501]

A review by the Commission of available information on the gas centrifuge machines built both here and abroad indicates that these machines cannot now be used in a production plant without further development work. So far, centrifuge units have been operated only as single laboratory models for isotope separation. These machines are complex and expensive. [Ref 7, p 501]

Even after substantial improvements have been made, thousands of gas centrifuges probably would be required to produce enough enriched uranium for one crude weapon per year. Including auxiliaries, a plant of this type might cost several thousand dollars per centrifuge. Compared with development by the United States, the time period would be much longer for a country not presently engaged in centrifuge research and development and not having access to advanced technical and industrial capability. [Ref 7, p 501]

There are already two methods—available today—to produce weapons material. These proven methods are (1) the gaseous diffusion method of producing enriched uranium and (2) the use of reactors, which produce plutonium. [Ref 7, p 503]

Three nuclear powers, the United States, the United Kingdom and the Soviet Union have built gaseous diffusion plants to produce U-235 for weapons purposes. In each case this has been a very costly undertaking and in each case the technology has been held very secret. Gaseous diffusion plants are inherently of substantial capacity and require very large amounts of electrical power. For various reasons, it is unattractive for many countries to proceed with the necessary effort to build even a small gaseous diffusion plant. [Ref 7, p 503]

France, for example, while planning to build a gaseous diffusion plant, achieved its first nuclear device from plutonium produced in reactors fueled with natural uranium. [Ref 7, p 503]

Technology applicable to the production of plutonium in reactors has been widely disseminated in the course of the program for the development of the peaceful uses of the atom, and this technology could be used to assist any country in attaining a weapons capability. [Ref 7, p 503]

For example, it is possible for a country to develop a plutonium production capability to produce one crude weapon per year with an investment on the order of $50 million. [Ref 7, p 503]

The results of the separation process, in terms of depleted and enriched fractions, are available only in the form of the indicated degrees of depletion, mentioned earlier, and the indicated degrees of enrichment shown in the AEC price list, are up to 90 percent U^{235}. (The degree required for weapons is not specified.) There is no information bearing on the mix of products of varying degrees of enrichment or depletion.

The value added by the separation process can be judged only by the uranium price list. It is suggested by some AEC reports that the price is adjusted partly from the point of view of the value of the uranium for peaceful uses and therefore is not necessarily an accurate reflection of production costs. With this as a reservation, however, it would appear simply from the price list that the product of the separation process is valued at about twice the value of the feed materials, or to paraphrase, the value added by the separation process is about equal to the value added by all previous operations.

The production of plutonium involves the operation of reactors fed in part with enriched uranium, followed by chemical separation of the plutonium. There are few data on the economic structure of this subindustry, other than the indicated value of the plants involved, and that value as stated for product reactors and separation areas presumably includes those for tritium as well as those for plutonium. For what it is worth, it stands at $1.6 billion (as mentioned earlier). The only other indication is in casual statements as to the price of

plutonium, which has consistently been priced higher than even quite highly enriched uranium. For example, at one time the price of uranium enriched to 90 percent U^{235} stood at $16 per g of contained U^{235}, and the price of plutonium was quoted at $40 per g. A more recent comment on the price of plutonium was simply that its value was at least $9 per g for power reactor use.

From the preceding, given that plutonium investment is about two-thirds that for uranium separation; that plutonium production operating costs are smaller than for uranium; and that the price of plutonium is higher than for uranium, then the quantity of plutonium produced must be some fraction of that of enriched uranium, implied as in the range of one-third to one-fifth.

The heavy-hydrogen industry has two main phases. First, heavy water has to be separated from ordinary water; second, the heavy hydrogen deuterium has to be processed in reactors to produce tritium. The heavy-water plants represent an investment of $260 million. Some sales of deuterium have occurred, but, so far as noted, no sales or price of tritium have been mentioned.

An alternative to uranium is thorium, which can be made the basis of a reactor-synthesis process for the production of U^{233}. This has been subject to little emphasis in the US program except that discussion of reserves of thorium can be found in recent AEC reports.

The major stage remaining to be discussed is the development, fabrication, storage, and maintenance of weapons. The annual cost of this in terms of annual operations has, as mentioned earlier, been about equal to the cost of raw materials, and about three-fourths as much as the cost of producing nuclear materials. The plant investment cost for this phase of the industry now stands at $800 million. The operating cost has tended to increase, although the costs of antecedent stages have begun to decline slightly in recent years.

MATURITY OF THE INDUSTRY

Like any major industry almost 20 years old with a large research component and wide range of technical advances, the nuclear materials industry is marked by a mixture of maturity and youth.

Several major peaks have been passed. For instance, the highest single year for plant construction was 1954 when the figure reached $1215 million. The highest annual cost for production of nuclear materials was in 1957, $763 million. The highest annual cost for procurement of raw materials was 1960, when the total of increasing domestic and continuing foreign purchases peaked at $717 million. The highest annual expense for reactor development, at least so far, was 1961, at $437 million.

On the other hand the cost of physical research has risen without a single drop between the annual figures from $31 million in 1950 to $172 million in 1962; and the operating costs for weapons development and fabrication have continued to increase, the highest figure being $706 million in 1962.

The domestic ore mills have long since passed the time when some mills have been abandoned because of process improvements or because nearby deposits of ore have been worked out. In the most recent report it was mentioned that some of the feed-materials plants had been closed down, this being connected with process improvements at others.

Prices quoted for materials at various stages given an indirect reflection of the great improvements in processing methods that have been accomplished gradually in the last 15 years or so. The average price paid for concentrates from domestic sources has declined from nearly $12 per lb in 1956 to $8.28 per lb in 1962 with $8 indicated as a fairly stable price for the future. Before 1956 the average price was considerably higher.

The price of uranium for sale by the AEC has also declined consistently. The price at 90 percent enrichment level has declined from $17 per g in 1956 to $12.01 in 1962.

The exploration effort to discover additional ore reserves has been substantially stopped, because ore reserves now known, with expected increments to arise from working, are deemed sufficient for some time to come. An interesting AEC statement on this is given in the AEC report of January 1963 as follows: (Ref 2, p 214)

> . . . The revised estimate of January 1, 1962, gave reserves totaling 71 million tons of ore containing 175,000 tons of U_3O_8. This is 3 million tons less than the tentative 74 million ton ore reserve figure previously published. However, the revised estimate of the U_3O_8 content of the ore reserves reflected a greater adjustment, being 36,000 tons of U_3O_8 less than the earlier figure. Until such time as another comprehensive review of ore reserves is indicated, the above estimate will be adjusted annually to reflect ore mined and newly developed reserves. Domestic ore reserves in place at the end of 1962 are estimated at 68 million tons of ore containing 167,000 tons of U_3O_8. This is a reduction of 3 million tons as compared with the estimate for the previous year. Although ore mined in 1962 amounted to 7 million tons, this was partially offset by the addition of 4 million tons of ore in newly developed reserves. Exploration has practically ceased except for more accurate delineation of known ore bodies. The quantity of ore milled exceeded the quantity mined by about 500,000 tons resulting in a corresponding decrease in ore in stockpiles. Stockpiles at the year end totaled 800,000 tons of ore containing approximately 3400 tons of U_3O_8.

On the preceding basis, it appears that the quantity of known reserves of ore is more than double the commitments for procurement of concentrates from domestic sources through 1970.

The AEC has now extended the time of delivery on all its commitments for concentrates from foreign sources and on some of its commitments from domestic sources.

In summary the methods of extraction of concentrates from ores have become very efficient. Further processing stages have become more efficient than formerly, and in sheer scale the operation is no longer in the class of "a growth industry." So far as uranium is concerned the industry has reached a high degree of maturity in both scale and technique.

Plutonium production will apparently reach maturity in scale in the near future with the completion of one major additional reactor at Hanford.

There are clear indications throughout the recent AEC reports that the uranium-producing industry is now in something that might be described as a "holding" phase. Activities are being continued at a level to keep the entire operation vigorous until the time when civil requirements will supplant military requirements as the base of demand. To illustrate, the AEC report of January 1963 states . . .

> On November 17, the Commission announced a "stretchout" program for domestic uranium procurement for the 1967-70 period. The new program consists of a deferral to 1967-68 of a portion of the uranium now contracted for delivery to the AEC before

1967 and the purchase, between 1969-70, by the AEC of an additional quantity equal to the amount deferred. This will assure uranium producers of a market until the anticipated requirements of private power reactors are more firmly established. [Ref 2, p 12]

NATURAL PROPERTIES AND THEIR ECONOMIC CONSEQUENCES

The nuclear industry deals with materials having certain unusual properties. The natural properties in turn have certain unusual effects on the economic structure. The most important of the properties is radioactivity. The next most important is the special property of isotopes, that they are inseparable by ordinary chemical processes and separable only with difficulty by any other technique.

The industry has to deal with certain radioactive materials as desired and useful products, and with a great many others as more or less haphazard by-products. The desired and useful products happen to have a fairly low rate of radioactivity and consequently a very long half life, together with the two primary source materials shown in the accompanying tabulation.

Chemical element	Half life, years
Thorium 232	1.39×10^{10}
Uranium 233	1.65×10^{5}
Uranium 235	7.07×10^{8}
Uranium 238	4.51×10^{9}
Plutonium 239	2.41×10^{4}
Tritium	12.4

Consequently thorium, the three isotopes of uranium, and plutonium have ordinary rates of decay that have no significant economic effect. The half life of plutonium is considerably longer than the period of recorded history in human affairs, and the loss in a decade is insignificant in quantity. The others are longer lived.

Tritium is the only material having important use whose half life is of economic importance. The stockpile of any material that decays at a constant rate and is produced at a constant rate cannot exceed $1\frac{1}{2}$ times the quantity produced in one half-life period (1.4427 of half life, to be exact). Consequently for tritium, if any definite stockpile requirement were established, production would have to be maintained constantly at a rate not less than about 5 percent of the required stockpile per year. In contrast if any absolute fixed stockpile requirement for U^{235} or for plutonium were set, the stockpile might be attained and production might then cease.

The radioactive by-products include isotopes of a great many elements. Some of these are useful for certain medical and research purposes in small quantities, but in large part they are useless. Considerable quantities have to be disposed of as "radioactive waste." In contrast to the long half life of most of the useful materials, one of the beneficial properties in the whole situation is the very short half life of some of the nuisance materials. This can be seen in the accompanying tabulation. However, there are exceptions of which strontium 90 is the worst, with a half life of 25 years corresponding to

a quite high rate of radioactivity together with a quite significant degree of persistence. Another with a long half life is potassium 40, but its half life is 1.5×10^9 years, which although it permits accumulation also involves quite a low rate of radioactivity.

Chemical element	Half life
Sodium 24	14.8 hr
Selenium 81	17 min
Bromine 87	55.6 sec

In general then, the useful radioactive materials have such long half lives that the loss rate is insignificant, tritium being the exception, whereas the less useful or useless by-products have such short half lives that they cannot constitute a long-term nuisance, strontium 90 being the outstanding exception.

For the materials with very long half lives, stockpiles are substantially cumulative to any practicable and desired level. In a way comparable to the world's stockpile of monetary gold they reflect the accumulation of all past production, minus only the fraction dissipated in the course of use. Also, like the stockpile of monetary gold, the rate at which they can be increased is restrained by considerations of cost, but there is no particular impediment to a steady annual rate of production at some reasonable level.

The industry involves two major cases of the separation of isotopes: first, the partial separation of U^{235} and U^{238}, and second, the separation of heavy water from ordinary water to separate deuterium from hydrogen. Each of these processes depends on the difference in physical behavior of the isotopes related to the difference of mass. The difference of mass is a far smaller difference in terms of degree in the case of uranium.

Natural uranium, as is well known, contains 0.721 percent, or 1 part in 140, of U^{235}. As pointed out in the Smyth Report,[1] to change the concentration of U^{235} from 0.721 percent to 90 percent requires changing the ratio of U^{235} to U^{238} by a factor of 1260 (9/1 : 1/140 = 1260). This suggests what the physical basis is for the extremely extended process of separation by diffusion.

The percentage of deuterium present in natural water is even lower than the percentage of U^{235} in natural uranium, being 0.014 to 0.015 percent.

The separation of uranium isotopes can be by gaseous diffusion, centrifuge, or mass spectroscope, with the first serving as the economically significant method in the US and, apparently, in the Soviet Union. The centrifuge apparently awaits further technical progress before it can assume a significant role (see the section "Structure of Industry"). The separation of heavy water from ordinary water can conceivably be by fractional distillation as well as by the other processes since the boiling point differs significantly.

It is assumed that the properties of radioactive materials that make them useful for explosives or power do not require discussion here.

In some ways the nuclear-materials industry has further interesting similarities to gold and diamonds. All three involve the separation of very small quantities of material from initially very large quantities of dross. All three result partly in permanent stocks, with some use-up of a portion. Gold and

diamonds are both a great deal simpler in their extraction processes, of course, than are the two- or three-stage processes required for U^{235} or plutonium or tritium. Diamonds involve the separation of an even smaller quantity from an even larger quantity, there being 1 part of diamonds to 14 million parts of diamond-bearing rock on the average. The value of rough industrial diamonds is about $4 a carat or $20 a g, whereas the value of rough gem diamonds is about $32 a carat or $160 a g. The annual world production of natural diamonds is apparently about 4½ tons of industrial and 1 ton of gems. Gold at $35 per troy oz is worth about $1.01 per g, so that enriched uranium at 90 percent U^{235} at $12.01 per g costs 10.9 times as much as gold by weight.

RELATION OF TIME TO SCALE

Nuclear products are durable and immune to obsolescence, and only a small fraction is used up in peacetime. A stockpile can accumulate over an extended time. Elapsed time is therefore a determining factor just as important as rate or level of production. In the simplest sense, if a given quantity is produced every year the accumulation will equal that quantity multiplied by the number of years since the beginning. There are several very significant and interesting complications, however.

The very large "hold-up" in the uranium diffusion plant means that if the plant is completed and processing starts, the flow of output does not reach a normal level until a considerable time thereafter. This is one very important element in start-up time. The time to build plants is also a very large element. Even thereafter the lag between the amount of ore mined or of uranium oxide procured and finished weapons, must be at least a few years in a mature industry. An earlier quotation mentioned a stockpile of 800,000 tons of ore at ore mills, and there are further working inventories all along the line as well as goods in process. When all of this is considered, it appears as a very remarkable achievement that the US was able to fabricate three atomic weapons before the end of WWII with most of the work, including construction of plants concentrated in no more than 3 years.

In addition the American industry in its simple economic structure now reflects the time dimension in terms of technical progress in all the important processes. The separation of concentrates, production of feed materials, and diffusion technology have all been subject to important technical advance, as indicated at many points in the published reports of the AEC and as reflected in reduction of costs. This is in part related directly to what is commonly called a "learning curve" but also has involved fundamental advances of technology.

The importance of all this lies in its relation to strategic power considerations. Ever since the first Russian nuclear explosion in August 1949, there has been quite intensive discussion of the effect of nuclear capabilities on strategic power relations. The subject has had three characteristics that have affected the character of the intellectual discussion: (a) it has been of striking importance, largely obscured by secrecy, and involved with somewhat complex and previously quite unfamiliar phenomena, (b) it has therefore been characterized by considerable emotional intensity, and (c) there is constant coining of terminology that has included a large by-product element of slogans. Examination of the literature can readily demonstrate that an assumption has often been made

that one atomic capability is strategically equal to another atomic capability. Thus also, beginning with the phrase "the absolute weapon," there has been much discussion of "the nth member of the nuclear club," of "nuclear stalemate," etc.

To restore perspective it is important to insist that "the nth member of the nuclear club" will have a nuclear capability at any time measured by the scale of his industry and the length of time during which it has been producing end products. The time at which any nation attains any given stockpile will be the appropriate time required to accumulate a sufficient multiple of the annual production after the full flow of output has been attained.

Also no nuclear industry in reality will represent a simple decision as to scale of production with automatic attainment of production at US costs, since the processing improvement factors will require a great amount of time in any country. At the risk of adding one more simplification, then, there is a dead time for construction and for filling the system with goods and processes that approximates 3 to 5 years, and an improvement time of 10 to 15 years before all process improvements have been carried through, not to a static, but to a more mature condition.

This permits consideration of what is involved in "joining the nuclear club." For a given scale of industry, it will take 10 years before the stockpile represents about 5 or 6 years' annual production. Alternatively to attain a given stockpile at a time 10 years from start, the industry must be large enough to produce about one-sixth of that stockpile per year. To attain it in 20 years, on the other hand, would require an industry capable of producing one-fifteenth of it per year on the average.

Actually only a quite small, so to speak, token industry could be produced as a single slice without later modification. Any industry approximating the size of that in the US would require progressive addition of slices over an extended time, with gradually increasing production until full maturity of all slices, perhaps a decade or more.

Instead of speaking of "joining a nuclear club," one might better speak of "buying shares" in the nuclear fund. The fund is open to subscriptions, but the members have as many votes as they buy, and the member who has been investing heavily for a long time has many more votes than a member who invests equally heavily for a shorter time or who invests only lightly even for a long time.

There are only two ways to attain equality with the largest stockholder. A new stockholder can attain equality with any older stockholder by investing more heavily for a long enough time to catch up. But also there is the concept of "nuclear plenty," which is not without some real significance. That is to say, there is some quantity of materials that, if fully fabricated into a complete mix of weapons, would represent so many weapons that further increments would have no military or strategic value. If our leading stockholder should attain a level of absolute nuclear plenty, then another stockholder could eventually attain strategic equality regardless of further increments added by the former leader. The level that might represent absolute nuclear plenty is discussed in a later section. Short of that level, however, differences in stockpiles of different nations must not be denied military and strategic significance, and the members of the nuclear club need not be regarded as equal.

There is one more relation worth mentioning. If the nation with the largest

production rate and accumulated stockpile can foresee the attainment of nuclear plenty within a period of years, it may be practically impossible for any competitor to overtake and surpass that leading nation within the time before the leading nation attains the level of plenty. For example, if nation A has an accumulation and a rate of production such that the level of plenty will be reached within 10 years, it might be entirely out of the question for any other nation to attain an equal or superior stockpile level at any time in the interim.

The statement obviously rests on some assumptions based in turn on economic considerations. If there were no practical physical limits to the scale of a uranium industry, then any nation willing to pay the price might create an industry of any desired scale. The scale in purely monetary terms is not too imposing, as reflected in the fact that the entire US investment in the products of the nuclear industry to date is less than 1 year's annual defense budget at this time. If money were the only required resource, several nations might be able to copy the American stockpile (but not the military systems to use it) in quite a short term of years. One point of this paper is that no such thing is possible; the material and technological inputs required cannot be bought with money without regard to time and resources.

The US started its industry on the basis of uranium concentrates obtained from foreign sources. Sufficient uranium ores have been located in the US to make the US independent in all practical considerations for the future. The US undertook a diffusion-separation operation on the basis of a gigantic electric power factor, based on very cheap coal of very excellent quality. Although judgment is that the centrifuge process may in the future permit a large saving in electric power, it is not regarded as capable of attaining a radically superior economic position. The US has been engaged in the industry for 20 years with enormous benefits now in effect because of process improvements. It is very plainly implied in recent AEC reports that the US is, so to speak, "coasting." It seems impossible to find any reason why the US should now press with any greater urgency than it is doing, at least in the basic element of the industry concerned with uranium.

PRIMARY MILITARY RELATIONS

The military relations will be dealt with only in extremely summary fashion here.

There are three main considerations involved in proceeding from the structure of a nuclear industry to the military significance of its products. First, any given stockpile must be translated into terms of quantities of weapons; second, quantities of weapons must be translated into military effects in terms of the effect of single weapons and the potential effect of numbers; and, third, quantities of weapons holdings in existence must be translated into terms of quantities of weapons that might actually be employed. Precise quantitative data on each of these three logical steps must be omitted here, but the logic can be explained.

First, although almost total obscurity as to the scale of the US stockpile was maintained for many years by official sources, there have been several positive statements of some significance in recent years. One of the first was

made by Secretary of Defense Gates to the Preparedness Investigating Subcommittee of the Senate, on 16 March 1960, in part as ". . . we have nuclear weapons that exceed those of the USSR by several times in destructive power."

It has also been stated by American authorities that the US has some tens of thousands of weapons (there is also a statement by Khrushchev giving the number as 40,000 weapons). Public knowledge remains quite imprecise otherwise. Vague as this is, it is quite sufficient for significance in several further connections.

Second, the military effects of nuclear weapons are not described in detail in any unclassified source. However, the basic physical effects, immediate radiation, delayed radiation, thermal radiation, and blast are described in considerable detail in an unclassified Department of the Army[8] publication.

The most important military effects are due to initial radiation and blast. Data on these are summarized in Table 5 (in the appendix), for only one value of radiation exposure and one value of damage by blast, these being sufficient for the purposes of this paper.

The military use of nuclear weapons requires delivery systems as well as weapons. The delivery systems include long-range bombers, missiles, nuclear-missile-firing submarines, and tactical weapons ranging from artillery to rocket-propelled missiles varying from quite short to very long ranges.

Without indulging in any further detail, the following facts are apparent:

The military use systems are of much higher economic cost than the nuclear weapons themselves. Secretary McNamara, in his speech at Ann Arbor, Mich., 16 June 1962, stated that "During the coming fiscal year, the United States plans to spend close to $15 billion on its nuclear weapons. . . ." At this rate the military systems cost far more than the warheads. They are not, however, subject to comparable resource restraints, and to some extent it might be said that any country that can afford them can have them.

The long-range systems required for a capability to use nuclear weapons worldwide are far more expensive than systems for using nuclear weapons at much shorter ranges.

Nuclear weapons do add a degree of capability different from what conventional weapons could attain, regardless of cost. One need only examine the relative cost of TNT in equivalent quantities and the possible means of delivering it. The price of TNT was recently $0.20 to $0.22 per lb. At that price a 20-KT weapon would cost $8 million for the explosive alone. It would, incidentally, require not a bomb, or an airplane, or a missile, but two fair-sized freight ships of 10,000-ton capacity each to transport that quantity. Anyone interested can calculate for himself the cost and delivery means involved in megaton weapons made from TNT. In terms of crude yield, it appears that atomic weapons cost a small fraction of the cost of TNT, with the additional factor that the delivery means, although expensive, are not impracticable.

In terms of so-called "strategic" attacks on the industrial and population base of national power of any nation, it is amply evident that a major nuclear capability permits effects of a "paralyzing" nature. Table 6 and Fig. 1 (in the appendix) present a very crude measure of the quantities of weapons whose damage areas would be equivalent to the areas of familiar geographic units, including many nations. The data presented are extremely crude, especially because any nation could be paralyzed by attack on a small fraction of its sheer

area, and the number of weapons required to paralyze a nation would be only a small fraction of the numbers indicated.

The crude measure of blast-damage area against the area of a nation tells more in relation to strategic than to tactical military values. Nuclear battlefields may be rather large if they occur, but they do not necessarily extend to entire national areas. At any rate, if nuclear weapons are considered simply in terms of their comparative effect relative to conventional weapons, it is obvious that a few nuclear weapons can accomplish an effect against an army on the ground far beyond any former capability. The radii mentioned in Table 5 or the circular areas mentioned in Table 6 can obviously be laid down either as a destructive fire on a line or on a local area with great effects against any army in that area. However, the conditions on which this might be done are highly probabilistic and debatable, as is also the extent to which it would be done, if it were done.

Third, an important relation exists between the scale and maturity of a nuclear industry and the military forces that utilize the resulting capability and the fraction of an available stockpile that would be used, if used at all. This matter has been rather neglected but seems worthy of mention. There are several reasons why the larger and older the nuclear capability, the smaller will be the fraction of weapons that would be used.

There are several reasons for this. First, if there were only a few weapons, all of offensive character and all used against ineffectual defenses, it is conceivable that 100 percent would be used and 100 percent would be effective. This was the case in WWII when, with three weapons produced, and one used for a test, the entire supply of two remaining weapons was used militarily with great effect.

At more advanced stages, considerable numbers of warheads may be allocated to defensive weapons: for instance, to antiaircraft missiles or to antimissile missiles. These in turn are of somewhat limited range in the necessities of the case and therefore deployed rather widely. They would all be fired off in war only if the allocation of an enemy attack were such as to nicely match the defensive deployment. However, as with ammunition for coast defenses in former times, a large fraction of such defensive ammunition deployed at many points is never expended. Maturity also brings increasing complexity of mix and a variety of special-purpose offensive weapons. This contributes further to the probability that a large fraction will never be expended, since the mix must be designed for all contingencies but not all contingencies will arise. Further, so far as defensive weapons can be effective, one defensive weapon of moderate yield will, if it kills an offensive weapon, presumably result in a smaller total yield expended in actual explosion, and in far less damage and fallout. Thus at an advanced stage when a nation may have thousands of warheads they are absorbed in an extremely varied system of offensive and defensive weapons, and even in the most extreme all-out exchanges the fraction that would be targeted and expended effectively tends, as the stockpile gets larger, to become a smaller and smaller fraction of the total available. No pretense will be made here to quantify this relation beyond the adjective statement. It stands, however, as a corrective of any impression that might otherwise prevail, that the destructive effect in a nuclear war would be measurable as the effect of all

the weapons available when it occurs. More briefly, the bigger the stockpile and the more mature the military capability, the smaller the fraction of the existing nuclear ammunition that will be used. Correspondingly the more mature the capability of the more advanced nuclear powers, the larger the requirement of weapons available for any specified actual effect.

To summarize all the preceding:

(1) The material scale and age of the American nuclear industry permits a number of bombs in the tens of thousands.

(2) Destruction can be wrought to very great areas by the usable fraction of such numbers of bombs against civilian or military targets.

(3) Only a very small stockpile might be completely expended in war; if a stockpile is very large, only some fraction of it will be expended even in all-out war.

The concept of "nuclear plenty" then remains to be examined more closely. The term has been widely used, and used as if it means simply that the use of nuclear weapons for any appropriate military purposes in war would not be restricted by short supply. This needs somewhat more logical detail for understanding.

Given the power of nuclear weapons it is evident that some numerical quantity could be enough, if used effectively. However, that number would not directly constitute plenty because of various factors involved in the relation of the quantity on hand to the quantity that could be used effectively, somewhat as follows. We can start with the net quantity that would be enough if applied, and proceed to the gross that would be enough, if on hand.

Enough for the strategic purpose of crippling an enemy must mean enough delivered effectively, plus an allowance for losses to an enemy surprise attack of counterforce character, plus an allowance for losses to enemy active defense, plus the normal allowances for duds, aborted sorties, etc.

Enough for tactical purposes must mean enough to deter, equal, or surpass the enemy in tactical use if it occurs, with tactical delivery systems of short to long range such that the enemy cannot deliver an effective counterforce attack that would cripple our retaliatory capability, either by precision or blanket attack on the area containing our weapons.

Enough for active defenses would mean enough to provide a defense that could impose a large loss on the enemy attacking system, with the requirement imposed on the enemy to allow enough added to his system for attack on any target, so that in turn he cannot attack all targets in sufficient strength for assured success. This means defensive weapons on our side deployed at all the major targets he could choose, with the expectation that he could not actually attack them all. In short, our active defenses must be greater in the aggregate than would be necessary to severely cut his attack if his target selection were accurately known to us.

All the foregoing is subject to the consideration that for absolute plenty it would have to be plenty against any probable combination of enemies. On an absolute basis it might have to be enough to destroy all the land area of the world. This might still be attainable, so far as weapons alone are concerned.

However, one general limitation remains. Although the nuclear materials are generally stable and are not subject to obsolescence, and therefore can be accumulated, the delivery systems are subject to severe obsolescence, and cost

much more than the weapons. The offensive and defensive systems are both subject to apparently unlimited technical advance. To conduct the advance means to accept the cost of replacement and obsolescence. Weapons themselves are also subject to advances of design and to somewhat costly refabrication, but this is relatively a minor factor compared to the cost of advanced offensive and defensive military systems. On this ground a limiting quantity of nuclear weapons or nuclear materials could be taken as such a quantity that the nation concerned could not afford delivery systems for any larger quantity, and this quantity may fall short of "plenty."

The preceding considerations do not serve to set a specific quantitative boundary line at which plenty is attained. However, they do indicate that there are levels below which it is not reached, and levels at which it would have been reached.

Most important, below the level of atomic plenty (all other things being equal, i.e., the efficiency of delivery systems, military skill, etc.), if one nation has significantly more than another this is of strategic and tactical significance. At or beyond the level of plenty the ratio ceases to be of significant concern. An urgent effort to increase the stockpile is then unnecessary, regardless of the scale of the enemy stockpile.

Evidence in the AEC reports is strong in the implication that the US is approaching the level of plenty with confidence that the USSR cannot attain superiority before the US reaches that stage (see appendix). It appears reasonable to recognize that this could be a firm and realistic matter. It could of course be correct or incorrect as to actual calculation, but it does not appear to be inherently incorrect in principle.

CIVIL USE PROJECTION

At the beginning of the development of nuclear technology, it was immediately recognized that vast potential benefits might arise, particularly in the use of nuclear energy for peacetime purposes. The use of nuclear energy for power has remained the primary promise although the technical difficulties before its fulfillment have proved more complex than was foreseen. However, there are now some power plants in operation for civilian use, and applications have been made for licenses for full-scale commercial power production. The exact extent of what amounts to subsidization, either overt or concealed in the favorable price for atomic fuel, is not clear. However, it is clear that atomic power for peaceful purposes is becoming a live economic factor.

The AEC's regular reports give considerable emphasis to the offering of atomic fuel for such purposes and to the prospect that the requirement for peaceful purposes will supplant the requirement for military purposes in the not too distant future. The AEC's special report on Civilian Nuclear Power[9] summarized the prospect as of that time.

By 1966 it appears that the competitive position of nuclear power plants had improved. In spite of advances on the side of coal, through the use of shuttle coal trains, etc., the new power plants contracted for in this year are more than half nuclear, and it appears that half or more of all future expansion of the US electric power industry may be in nuclear plants.

Outside the power industry, peacetime uses do not appear to be of great economic importance. Illustratively, there is a statement in the AEC report of January 1963 (Ref 2, p 53) "thorium, U-233, plutonium, present needs for these materials for peaceful purposes are very limited and essentially of a developmental nature."

In summary the use of the products of the nuclear industry for peaceful economic purposes is not yet large but appears to be on the brink of substantial economic development for power. If and as military requirements become less urgent because of atomic plenty, the requirements for peaceful purposes apparently will keep a very sizable nuclear industry in operation.

CONCLUSIONS

It would not be beyond the capability of any of a small number of major nations to pay the monetary cost equivalent to that of the US nuclear industrial effort within some term of years.

It would, however, be beyond the capability of any other nation to match the US nuclear industrial effort in the present or near future, because of non-monetary resource restraints, including both natural resources and technology.

The US nuclear industry is marked both by the extraordinary scale of some operations, and the very great advances in efficiency that reflect the 20-year history of the industry. The production of nuclear materials for military purposes has evidently reached an annual level of production at which no further expansion is deemed to be required.

The peak of effort in the AEC program has been passed at all major points (procurement of concentrates, plant construction, etc.) at some time in the past. Although the passage of time will bring further technological complexities in weapons and military use systems, it seems probable that there is a real level of plenty.

If a nation maintains a superiority in stockpile (and in delivery systems) until the level of atomic plenty is reached, the ratio of its stockpile to the stockpile of another nation will cease to be a matter of concern (if either had more, the excess would then be simply redundant).

For any nation that has less than the level of atomic plenty the ratio of stockpiles remains an important matter.

Atomic stalemate does not really apply except between two nations or groups of nations that have attained atomic plenty on both sides; short of that, a superior and an inferior military stockpile (delivery and defensive means) would represent a superior and inferior military and strategic position in this respect.

Although the attainment of a minimum stockpile of weapons may be characterized as making a nation "a member of the nuclear club," the significance of such a stockpile remains dependent on its quantitative scale; the members need not be regarded as equals.

The nuclear industry has just begun to assume an important and normal role as a competitive element in the peacetime economy, but appears to be on the threshold of such status.

TABLES AND FIGURE

TABLE 1

US Purchases of Uranium Concentrates[2,3,6,7,9-13]

(In short tons)

Years	Domestic	Foreign	Total	Cumulative tonnage
1943-1947	1,440	10,150	11,590	11,590
48	110	1,960	2,070	13,660
49	120	1,960	2,080	15,740
50	320	2,740	3,060	18,800
51	630	3,050	3,680	22,480
52	830	2,830	3,660	26,140
53	990	1,910	2,900	29,040
54	1,450	3,240	4,690	33,730
55	2,140	3,800	5,940	39,670
56	1,200	6,240	10,440	50,110
57	7,584	8,575	16,159	66,269
58	10,241	16,132	26,376	92,645
59	15,162	18,164	33,326	125,971
60	16,567	18,015	34,582	160,553
61	17,758	14,502	32,262	192,815
62	17,255	12,107	29,362	222,177
Total	—	—	222,177	—
Commitments	—	—	97,000	—
			319,177	

TABLE 2

AEC Operations and Plant Construction

(In millions of dollars)

Operation	Fiscal year													Total 1950–1963 included
	1962[a]	1961[a]	1960[b]	1959[b]	1958[b]	1957[b]	1956[b]	1955[b]	1954[b]	1953[b]	1952[b]	1951[c]	1950[c]	
Procurement of raw materials	537	637	717	700	595	398	279	194	143	82	73	188	168	11,344
Production of nuclear materials	689	733	731	713	750	763	731	588	410	318	206			
Weapons development and fabrication	706	512	505	492	444	337	281	259	250	257	229	164	112	4,548
Reactor development	433	437	399	356	306	255	169	115	99	104	64	44	32	2,813
Physical research	172	154	133	112	88	70	57	48	43	42	35	32	31	1,017
Other operations[d]														
Plant construction[e]	505	433	332	299	290	317	302	843	1215	1126	1082	459	256	7,459
Total operations	2696	2613	2619	2497	2299	1918	1608	1290	1039	905	684	495	415	21,078

[a]Data from AEC report (Ref 2, p 587).

[b]Data from AEC report (Ref 6, p 530 f).

[c]Data from AEC report (Ref 3, p 373).

[d]Includes biological research, education, and similar data omitted as of little interest for the present study.

[e]Ref 2, p 590.

TABLE 3

AEC Investment in Plant and Equipment[a,b]

(In millions of dollars)

Production	Fiscal years									
	1962[c] (June 30 include const)	1962[c] (June 30 completed)	1961[d] (June 30 completed)	1960[e]	1959[f]	1956[g]	1954[h]	1953[h]	1952[i]	1951[i]
Raw materials	3	3	4	10	7	7	—	—	—	—
Feed materials	283	277	270	253	252	221	—	—	—	—
Gaseous diffusion	2,354	2,348	2,345	2,334	2,315	2,284	—	—	—	—
Production reactors and separation areas	1,747	1,584	1,598	1,622	1,599	1,511	—	—	—	—
Weapons production and storage	752	724	838	803	785	490	—	—	—	—
Heavy water	164	164	163	163	262	737	—	—	—	—
Other production	248	245	236	272	333					
Research and development	2,005	1,714	1,435	1,271	1,125	716	617	548	Including above	Including above
Total, production	5,551	5,345	5,454	5,458	5,553	5,250	2,958[f]	2,133	1,635[j]	1,484[j]

[a]AEC investment in plants omits two classes of plants that are required for the industry but are left to private investment. They are ore mills, approximately $200 million, and electric power plants, approximately $1 billion.

[b]Accumulated depreciation is shown only on chart presentations of total plant investment, as something over $2 billion (Ref 2, p 589).

[c]AEC report (Ref 2, p 590).

[d]AEC report (Ref 6, p 533).

[e]AEC report (Ref 7, p 537).

[f]AEC report (Ref 14, p 621).

[g]AEC report (Ref 3, p 372).

[h]AEC report (Ref 13, p 72).

[i]AEC report (Ref 12, p 62).

[j]Includes research and development.

Comments on Table 4

Table 4 represents the logical structure of the uranium industry, but does not pretend to quantitative accuracy. Available data are taken literally at several points at which this may involve an unwarranted assumption. Also, data having reference value at a certain time are mixed with data having reference value at another time, e.g., the data in lines 4 and 5 are fairly recent and the data in line 18 are much older. The data in lines 13 and 14 are derived only from price lists, which only indicates that the degrees of enrichment and depletion indicated could be reflective of the result of the operation but not that they reflect actual practice. The data in lines 1 and 4 would apply if the data in line 5 happened to be given, and the quantities in all lines below line 5 also would apply only if the data in line 5 were given and all following factors were accepted also.

The table therefore is presented as having a kind of logical consistency for hypothetical quantities and factors that might pertain. As such, it exhibits the anatomy of the industry in a way that has significance for further lines of analysis and evaluation that are dealt with in the sections of the report that follow the one on "Structure of the Industry."

The table is intended to represent the general structure of a slice of a mature industry. One major feature might differ—if separation were by centrifuge instead of diffusion. If what the AEC says about the centrifuge is correct, however, this would change the detail, with less cost for power (and coal) but more for equipment, without changing the general scale of economic costs.

TABLE 4

General Structure of Uranium Production Industry[a]

Item	Multiply quantity in line	By factor	Quantity	Price	Total cost	Plant investment
1. Uranium ore	—	—	8,450,000 Stons	—	—	—
2. Mined	—	—	—	$ 6 per Ston[b]	—	—
3. Milled	—	—	—	$ 8 per Ston[b]	$ 68 million	—
4. U_3O_8 content	1	0.0026[c]	22,000 Stons	—	—	—
5. Concentrates recovered	4	0.91[c]	20,000[d] Stons	$ 8 per lb[e]	$320 million	—
6. Investment in mills	—	—	—	—	—	$200 million (private)
7. U contained	5	0.848	17,000 Stons	—	—	—
8. U contained, metric	7	10/11	15,450 mt	—	—	—
9. U^{235} contained	8	0.00721	111 mt	—	—	—
10. UF_6	8	100/67.6	23,000 mt	—	—	—
11. Fluorine	10	0.324	7,500 mt	$ 0.53 per lb	$ 8.5 million	—
12. Investment in feed-materials plants	—	—	—	—	—	$283 million (AEC)[f]
13. Enrich, U^{235}	—	To 0.90[g]	—	—	—	—
14. Deplete, U^{235}	—	To 0.0038[g]	—	—	—	—
15. U^{235} content, depleted material	9	38/72	58.5 mt	$ 0.79 per g	$ 46 million	—
16. U^{235} content, enriched material	9	34/72	52.5 mt	$12.01 per g	$630 million	—
17. Weight of enriched uranium	16	10/9	58.4 mt	—	—	—
18. Electric power per year	—	—	60 billion[h] kwh	$ 0.4 mils	$240 million	—
19. Investment in power plants	—	—	—	—	—	$ 1 billion (private)[i]
20. Investment in diffusion plants	—	—	—	—	—	$ 2.3 billion (AEC)

[a]The data used, as indicated in detailed notes, are not all for any one recent year. The general scale is set by the number 20,000 as explained in footnote d. The table therefore lacks precision. It is considered, however, that the table does indicate the major structural elements, and with some approximation to their proper relative scales.

[b]Prices are represented by sources as typical for US domestic mining; real prices vary considerably.

[c]The factors for content and recovery are recent average figures for US.

[d]This round number was selected as being of approximately the right magnitude and is the one that sets the scale for the entire table.

[e]The price is well below the past average but is given by AEC as future base.

[f]Process improvements have permitted closing some plants.

[g]The levels of enrichment and depletion used here are derived from the AEC price list, and not necessarily the predominant ones in practice.

[h]Verbal statement in January 1957 report[3] indicated about this rate for latter half of 1956.

[i]Based on average cost per capacity inferred, on data from Federal Power Commission.

TABLE 5

Weapons: Radius and Area of Effect

(By yield[a])

Measurement	Initial radiation[b]					Blast[c]				
	Radius			Area		Radius			Area	
	M	Yd	Miles	Sq mi	Sq km	M	Yd	Miles	Sq mi	Sq km
1 KT	550	600	0.34	0.4	1	300	340	0.19	0.11	0.28
10 KT	1,100	1,200	0.67	1.4	3.8	730	800	0.44	0.62	1.7
100 KT	1,650	1,800	1	3.1	8.5	1,800	1,970	1.1	3.8	10
1 MT	2,300	2,500	1.4	6	16	4,100	4,500	2.5	19.6	53
10 MT	3,200	3,500	2	12	32	10,000	10,600	5.9	109	310

[a]Data from Department of Army Pamphlet 39-3.[8]

[b]Data—in yards, from graph shown in the Department of the Army pamphlet (Ref 8, p 584), for 1000 REM.

[c]Data from the Department of the Army pamphlet (Ref 8, pp 637–38), in miles, for severe damage to reinforced concrete buildings, 11 to 15 psi.

TABLE 6

Familiar Geographic Areas and Blast-Effect Areas

Selected geographic unit[b]	Area, thous of sq miles	Yields				
		1 KT	10 KT	100 KT	1 MT	10 MT
		Radius for severe damage to reinforced concrete buildings,[a] miles				
		0.19	0.44	1.1	2.5	5.9
		Area of effect, sq mi				
		0.11	0.62	3.8	19.6	109
		Bombs needed for destruction of entire area				
Africa	11,500	—	—	—	—	105,000
USSR	8,600	—	—	—	—	79,000
Europe	3,750	—	—	—	—	34,400
CONUS	3,022	—	—	—	—	27,750
China (Proper)	2,279	—	—	—	—	22,500
NATO Europe (excluding Greece and Turkey)	725	—	—	—	37,000	6,650
Communist Europe (excluding USSR)	382	—	—	—	19,500	3,500
Texas	267	—	—	—	13,600	2,450
Ukraine	232	—	—	—	11,830	2,130
France	212	—	—	55,800	10,800	1,950
Poland	120	—	—	31,600	6,130	1,100
Italy	116	—	—	30,500	5,930	1,065
West Germany	96	—	—	25,200	4,900	880
Great Britain	89	—	—	23,400	4,540	817
Illinois	56	—	90,000	14,700	2,860	513
Cuba	44	—	71,000	11,600	2,243	403
East Germany	42	—	67,800	11,050	2,140	385
Jordan	37	—	59,600	9,750	1,890	340
Republic of Korea	37	—	59,600	9,750	1,890	340
Austria	32	—	51,600	8,420	1,630	294
Denmark	17	—	27,400	4,470	868	156
Switzerland	16	—	25,800	4,210	817	147
Belgium	12	109,000	19,400	3,160	612	110
Israel	8	72,700	12,900	2,100	408	73
Connecticut	5	45,500	8,070	1,320	252	46
Lebanon	4	36,400	6,450	1,050	204	37
Luxembourg	0.999	9,080	1,620	263	51	9

[a]From DA Pam 39-3 (Ref 8, p 638).
[b]Selected for scale and interest.

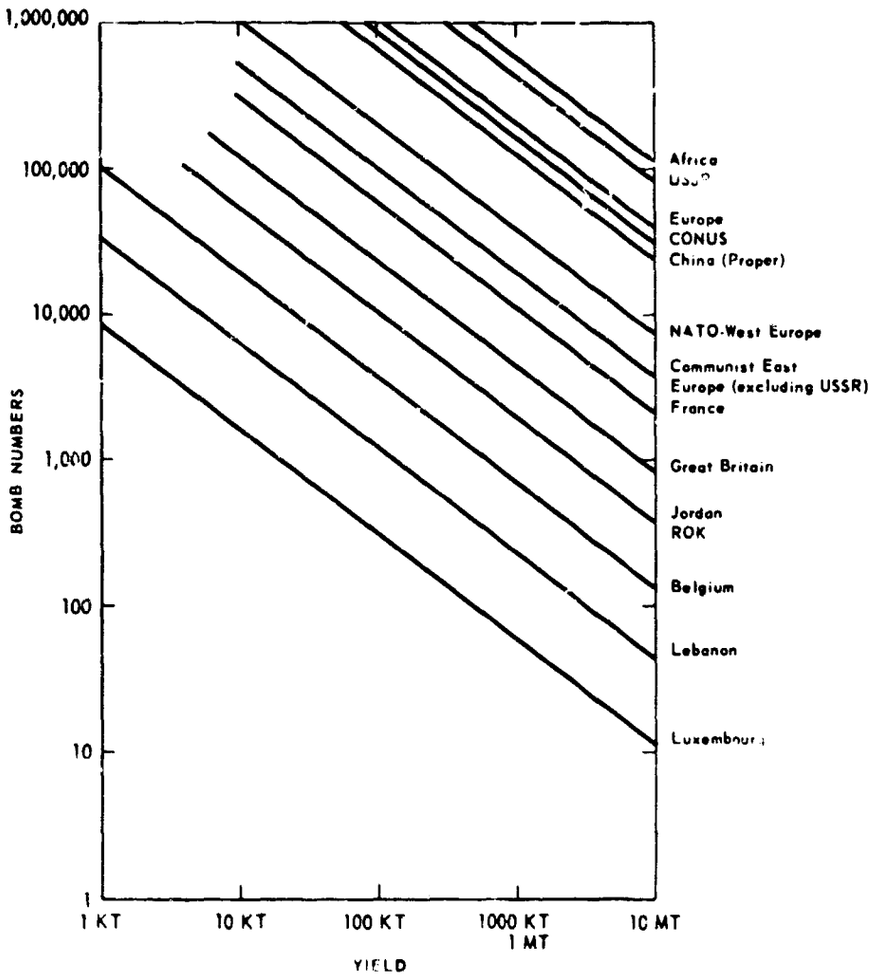

Fig. 1—Familiar Geographic Areas as Multiples of Blast-Effect Areas

Blast effect, severe to reinforced concrete buildings, 11–15 psi.

Appendix

THE NUCLEAR INDUSTRIAL BASIS OF NUCLEAR MILITARY POWER

STATEMENT BY THE ATOMIC ENERGY COMMISSION AND COMMENT

A statement by the Atomic Energy Commission was released on 2 July 1963 that has considerable interest in connection with the theme of this paper. Its text is as follows:

In response to news media inquiries the Atomic Energy Commission today issued the following statement concerning the production of fissionable materials for defense purposes:

During the early 1950s there was a major expansion of the facilities for producing fissionable materials and an all-out effort to develop uranium ore resources to meet the military requirements foreseen at that time. These efforts were very successful and production rates were substantially increased.

In 1959, after a study of future requirements it was decided to stretch out Canadian ore purchases over a longer period. A reduction of 1030 megawatts of electric power usage in the gaseous diffusion plants by June 30, 1964, was also authorized in 1961, and in November, 1962, the Commission offered a stretch-out program for purchase of domestic ores.

The plants for the production of fissionable materials now operating have a very high productive capacity and the question of need for employing their full capacity is continuously under examination. At present, long-range studies of military requirements for fissionable materials are under way. Decisions have not yet been reached as to specific changes in the AEC materials production program.

Comment

The disparity between the knowledge about the nuclear industry that is actually available on an unclassified basis, as exhibited in this paper, and the state of public information on the subject is well illustrated by the numerous press comments on the release presented above. The Washington Post on 3 July gave a fairly extensive report of the release and statements made by the Chairman of the Atomic Energy Commission in a public interview on 2 July, with little distortion, but also with no sharp appreciation of the details. The Minneapolis Tribune in an editorial on 2 July 1963 commented at length, including the statement ". . . what is in view is a suspension of production." This would seem to be a distorted interpretation. Walter Lippmann's comment (9 July 1963) speculated that

It is almost certain that Soviet military men and nuclear scientists think that their only hope of catching up with and overcoming American nuclear superiority is by some technological breakthrough which would require the explosion of big bombs in the atmosphere. But now Mr. K. has offered to forego such tests, and therefore to forego the attempt to achieve nuclear superiority over the Americans.

This would appear also to reflect an inadequate state of information on his part against which to interpret the release. No press comment so far as noted has called attention to the specific detail in the release concerning the reduction of electric power usage, presumably for lack of background information against which to measure it.

As noted in the AEC statement of 2 July 1963, the release appears to confirm the general impression given by other indications referred to in this paper.

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A Critical Review of the Nuclear Escalation Concept

CONTENTS

INTRODUCTION

The term "escalation" has become the name of a concept, or a subtheory constituting an offshoot from the theories concerning future warfare.

Theorizing on future warfare, and especially on nuclear war, has been intensely active since the late 1940's, when the unpleasant prospect of acute and possibly violent international struggle emerged again from the short period of optimism that followed WWII. Like any period of active theoretical effort, this has had the characteristics of a historical movement or trend. There have been numerous books, articles, and critical reviews. Important analytical ideas have emerged from time to time and have had substantial influence on further thinking. The motivation to think has been stimulated and directed by the flow and change of major facts and developments. The official and scholarly efforts have been made increasingly technical with the progress of time. Intense motivation is apparent throughout the texts.

At the same time, it has necessarily had the characteristics of the history of ideas. Some major premises have been given undue emphasis because of the clarity with which events have posed them. Others have been relatively neglected, because historical reality itself had seemed to understate them. Major logic structures have had an ad hoc and temporary character, insofar as they could only use the materials available and at a given real time. Reconstruction and revision of the body of thought have become progressively more difficult and laborious, both because the structure itself is more elaborate and complex and because a specialized community has grown up indoctrinated in the body of work and more difficult to persuade with a new bright idea than was the case in the earlier phases.

The body of thought has been influenced by the impact of new developments from several independent major realms. One of these is the cold war, with its history extending from about the time of Winston Churchill's speech at Fulton, Mo., in 1947. Another is the separate realm of Soviet behavior, capabilities, and intentions, especially as reflected by the internal history of Russia (and to some degree the internal history of China and some of the satellite nations). Another is the ongoing rush of modern technology, with its swift evolution through many stages, from the days of the B-29 and the P-51 through several generations of bombers and fighters and several more generations of missiles.

The world of nuclear war theory has therefore developed like a territory bounded by the other great factors of politics and technology. It has had layers or sectors within itself also. Historically considered, the growth of theory has gone forward on the several levels of research work in the major defense research agencies and on the levels of official policy and public expert comment, including books and articles, and also in the life of political discussions by the politicians, both intra- and internationally, while the evolution of the physical facts has pursued its own course.

One special factor has affected this internal ideological growth; there has been a barrier between the world of classified documents and the open public discussion. This barrier is not entirely impermeable; ideas and concepts to some extent move back and forth and across it, but it has been highly impermeable to many matters involving factual data. The public discussion has consistently lacked basic information on certain "classified" matters, and on some parts of the subject it has accordingly suffered in quality.

Such a large-scale development of thought and theory is regarded by its participants as largely rational; there is both necessity and some degree of propriety in this. However, in retrospect, one can well expect that historical critics will find ample evidence of faults and fallacies within it, and ample reflection of anxieties and emotional distortions. In short the process is of a somewhat ideological character.

It was evident, for instance, that thought about nuclear war in the period 1948–1955 or thereabouts was very preoccupied with the "all-out" or what some people called the "central" war and that this was both legitimate and distorted. It was legitimate because it was the new aspect on which analysis and doctrine were most lacking. It was distorted and distorting because it monopolized attention from any of the other aspects that have been brought to the fore more recently. The threat of all-out nuclear war lay over the whole field of concern like an indelible overlay. It generated anxiety and emotional preoccupation. It also generated a system of jargon or idiom of its own, which in turn both illuminated some parts of the problem and obscured others. Henry Wriston made an interesting remark about a single term once:

> . . . the expression "total war" has a deceptive simplicity and clarity. It can be quickly grasped. Like any slogan it is easy to remember. Constant iteration has a kind of hypnotic effect; it inhibits the reflection which would reveal the other half of the truth which the phrase suppresses.[1]

In addition to some elements of emotional bias and technical error the whole development has been somewhat subject to shades of partisan bias. There is no necessity to find special fault with any part to observe on the general fact. Books and articles from varied sources charge bias against various sectors of thought or official opinion. GEN Taylor's book, The Uncertain Trumpet,[2] offers some evidence on rather rigid positions taken on the part of the Air Force or the Navy at certain times. Without making any effort to show that one subsector of the nuclear war community is most at fault, or least at fault, one can venture the opinion that there has been some virtue and some fault on all sides. That is to say, all the services, academic world, publicists or columnists, and politicians have all made positive contributions to the growth of thought and knowledge and have all occasionally contributed to muddy the waters.

BACKGROUND OF US POLICY AND THOUGHT

The earliest serious thinking on nuclear war after WWI was concerned with the adoption of national policy on the new nuclear technology. In the late 1940's the US, reasoning with itself at the highest levels of the councils of

government, developed several elements of such policy. First, the US would deliver its nuclear technology in full to a competent world authority, if such authority could be established. Second, such an authority would have to engage very actively in nuclear research, because it would have to be assured of its own leadership beyond any secret advances by any nation. Third, it would have to have the right of inspection within all nations. Fourth, in the absence of agreement on such an authority, the US would perforce retain its nuclear technology, and pursue its advance, under secrecy, in the guise of something like a trustee for the world.

In addition, certain organizational arrangements within the government were designed and established, the Atomic Energy Commission (AEC) and the Joint Congressional Committee on Atomic Energy.

Finally, the US reluctantly, but with an increasing scale of energy and effort, went on with the development of long-range means of delivery (the B-36, B-47 . . .) and with the development of nuclear technology itself.

The principles summarized above were contained in the proposals initially identified as the Baruch proposal, and later identified with the Acheson-Lilienthal Report.[3] The unilateral decision to develop nuclear technology and capability was expressed in the programs for nuclear production, weapons design work, and tests of the AEC, and maintenance and progressive development of the Strategic Air Command (SAC).

The condition of American thought in the earliest phase can be exemplified by quotations from the report of the President's Committee on Universal Military Training in 1947:[4]

> The past year's effort to establish an effective international body for control of atomic energy in the interests of peace has been unsuccessful. Even worse, the reasons for this failure are such as to suggest the need for an intensified national security program as prudent national insurance.
>
> . . . the era of push-button warfare, in which intercontinental rockets with atomic warheads wipe out tens of millions overnight, has not yet arrived. . . . . Both the scientists and the military experts who appeared before us testified, with the utmost conviction, that push-button warfare in the sense that has gained such widespread popular acceptance is not a development of the foreseeable future. On the other hand, it was freely predicted by the scientists that such warfare might become a reality within 25 years.

The swift acceptance of the necessity for nuclear power was shown in the Finletter Report on Air Power in 1948:[5]

> The conclusions of the Commission thus fix as the target date by which we should have an air arm in being capable of dealing with a possible atomic attack on this country at January 1, 1953.
>
> The strength of the counteroffensive force must be such that it will be able to make an aggressor pay a devastating price for attacking us. It must, if possible, be so strong that it will be able to silence the attack on the United States mainland and give us the time again to build up our industrial machine and our manpower to go on to win the war.

The further shift from short-range to a very long-range position was developed after 1953, and can be illustrated by a quotation from Admiral Radford in testimony to the Senate Appropriations Committee in 1955:[6]

> It was in recognition of the Communist objective and their methods for attaining it that the President directed that military planning no longer be based on the year-of-crisis theory but on preparations for the long haul.

The parallel development in American policy and thinking was involved with the recognition and acceptance of the cold war as a condition. This progressed through a series of stages, under the impact of events as American Presidents and Secretaries of State gradually reached the conviction that relations with Russia, rather than friendly, would be at a level of antagonism just short of war. Such events as the communization of Eastern Europe along Stalinization lines; the seizure of power in Czechoslovakia in 1948; the Russian opposition to the Marshall Plan; the sensational spy trials in England, Canada, and the US; and finally the Korean War in June 1950 were the facts in evidence that brought official and public acceptance of the cold war. By 1949 the Marshall Plan had become an instrumentality to salvage West Europe against the threat of Communist take-over, and the North Atlantic Treaty Organization (NATO) Alliance was formed. The problem of policy in the cold war developed around the issue of containment and the hazard of overcommitment, an issue on which George Kennan and Walter Lippman, among many others, had much to say. In the meantime there was a long series of confrontations, first in Azerbaijan; then the Berlin blockade; the long-drawn-out guerrilla wars in Malaya and Vietnam; the Communist seizure of China; the war in Korea from 1950 to 1953; and the crises over the offshore islands, of Suez, Lebanon, Iraq, and latterly over Cuba. The policy of containment was implemented by the development of the Southeast Asia Treaty Organization (SEATO) and Central Treaty Organization (CENTO) Alliances in addition to NATO. The US policy of military aid was applied worldwide.

Through the whole series of policy developments and overt critical incidents, two great characteristics have emerged. As shown at some of the points of confrontation such as Berlin and the offshore islands, the world situation exhibited something like rigidity, but in the conduct of some of the incidents it has also exhibited, more evident in retrospect than at the times, an aspect of resilience.

In the period 1946–1950 there was a transition from optimism about the world situation to general acceptance of the cold war by the government and the public. At the beginning of this transition there were few people who regarded the Soviet Union or the world Communist movement as highly antagonistic to the interests of the US. During the transition those who recognized the cold war condition as an objective fact increased in numbers with every demonstrative event or turn of policy. Only with the Korean War, however, did it become possible for the US to act with unity of purpose, and therefore with a large-scale national effort. During the interim those who were most aware of the national danger were also acutely anxious because of the disparity between the greatness of danger and the paucity of the means applied to counter it.

During this period there were many who wondered why the USSR did not simply invade and seize all Western Europe. During that same period the military assets of the US, which might have deterred such a gambit by the Soviets, were just two:

(a) The monopoly of atomic capabilities together with a great strategic Air Force (by the standards of that day), and

(b) The demonstrated capacity of American war industry to support a war on a level of overwhelming superiority, given time.

Under those conditions the concept of deterrence was as much discovered as it was invented. That is to say, it was as much the answer to the question: Why has Russia been deterred? as it was to the question: How can war be avoided? In this the US Air Force was quite naturally ready to appreciate and exploit a concept that assigned to it a most significant role.

The concept of deterrence was no sooner formulated in simple form than it began to generate a growth of more complex doctrine. The first extension was in the concept of "graduated deterrence" as Secretary of State Dulles suggested it, together with other terms he used, especially "massive retaliation" and "the brink of war." At every later stage in the argument the addition of a few new terms and bits of logic was immediately pounced on by critics as begging further questions and giving rise to new areas of analysis and theory. In its original form, graduated deterrence meant only a greater or lesser quantity of atomic attack, performed in any case by mid- or long-range manned bombers. In the later development of the jargon of the subject, this is called "extended deterrence" since it is an extension to minor and various occasions of the capability to deter that rests in a single homogeneous deterrent force. The term "graduated deterrence" has largely disappeared as a term of value in the discussion. This seems more due to the circumstantial weakness of its original form than to its lack of logical merit.

The notion of "mutual deterrence" also arose in the early years. One shock to the American official and popular estimation of the Soviet Union was the first Soviet atomic test in 1947. This was an event of very complicated significance. It strongly reinforced the anxiety generated by spy trials. It strongly contradicted the prevailing attitude about Soviet technical and industrial inferiority. In the absence of any public knowledge of quantitative scale on the American stockpile, it introduced an adjective term, "the Soviet has attained an atomic capability" that could be used as if equal to the US atomic capability. This precipitated thought along the lines that the US deterrent could no longer be thought of as extensible. It could not be frittered away on any minor threats, because then it would become inferior and inadequate to hold up its end in mutual deterrence against the main Soviet threat.

In the meantime the recognition of nuclear power as a deterrent made NATO problems difficult from the start. Those who believed in the deterrent power of SAC found it difficult to believe also in a serious conventional military effort in the European NATO nations. Hence the NATO forces were thought of by some as a "trip wire." Also the best argument for stronger NATO conventional forces rapidly became associated with the idea of mutual deterrence of the use of nuclear forces between the US and the USSR.

While the doctrine was developing its magnificent foliation and complexity, the materiel developments, policies, and measures went massively ahead. The swift attainment of an atomic bomb by the USSR was accepted as making the decision on development of the H-bomb an urgent problem. The US, with some internal and external controversy, did decide to attempt H-bomb development and by 1952 could only have been glad that it had done so, since the Russians produced an H-bomb only shortly after the US.

Between 1946 and 1956 the whole trend of development in events and in thinking had one very clear consequence. The US never wavered seriously

from maintaining the strongest strategic Air Force in the world and from developing what was undoubtedly, at all times, the largest stockpile of nuclear weapons under constant growth. The US AEC and the US SAC enjoyed the position of priority claimants, as against other US forces and NATO forces. The policy of constantly maintaining the US strategic nuclear capability has never been seriously brought into question as being wise and reasonably successful.

There was also one clear condition worthy of note though seldom mentioned. A strategic nuclear attack capability was the first form of force in the world's history whose capability was so great and cost so low, relatively, that decisive effects might be gained without extended mobilization of war industry over a period of years. In short, such a force could be in being at all times without undue economic and political strain.

The ideas and theories of 1950 were quite adequate to justify the major efforts for research and development and for the development and maintenance of ready forces. The research and development effort in unparalleled scale has brought a swift evolution of the material means. The evolution of the material means has in turn generated new problems for policy and doctrine. The thinking has in turn oriented research and development toward new goals for needed hardware. Since 1950 we now have had 14 years of this extraordinary process.

Even in the late 1940's the Army had begun to seek the development of tactical atomic weapons. The first practical form was the 280-mm gun, the superbly modern weapon for what now seems a brief moment in time, a long time ago. This was rather rapidly supplanted by the development of missiles of types now regarded as rather primitive—Redstone, LaCrosse, and Honest John. They served at least in part to answer the question, how could inferior numbers of US and NATO forces hope to deal with greatly superior numbers of Soviet divisions if a major ground war in Europe were to occur.

Shortly after the attainment of a nuclear capability by the USSR, came the evidence of a Soviet strategic-bomber force. This soon raised the specter of a radical advantage to the side that might strike first, since the strategic nuclear forces of those days were largely concentrated on major air bases, which might, at least in imagination, be all too easily destroyed by a clever surprise attack. Such a possibility might make it possible for one side to nearly or entirely destroy the atomic delivery capability of the other side. This possibility was pointed out with emphasis by Wohlstetter, and the gist of his thesis, "The Delicate Balance of Terror" was published as an article in Foreign Affairs.[7] The very important influence of that idea dates to some time earlier.

Of course the possibility of a really two-sided nuclear war brought an emphasis on possible defenses also. The introduction of vastly more effective defensive weapons actually saw no lag after WWII. The last very radical gun-type weapons were available by 1950 and the first much more radical and effective missile-type weapons shortly thereafter. The problem was posed, what proportion of national effort should be devoted to the offensive arms as against the defensive arms, and in the years from about 1953 to 1960 or later there was active controversy on this issue. There can be no methodical demonstration of the exact optimum mix of offense and defense, but the principle that some defense can be better than an exclusive emphasis on the offensive capability was accepted as early as the Finletter Report of 1948[8] and has never been

seriously shaken. However, there were some proponents who demanded vastly increased defensive efforts and others who attacked such proposals.

The stretch-out of time, with the production of fissionable materials and of other materials for fusion weapons progressing toward ever greater accumulations, with increasing buildup of delivery capabilities on both sides, raised the prospect of total destruction. Herman Kahn devoted a great deal of attention and analytic ability to examining this. The primary effect of his work was to point out that, no matter how great the nuclear attack capabilities might become, they could not destroy everything in the US, or in the USSR. Consequently the value of passive defenses was a legitimate problem, and, as he pointed out, a major program in passive defenses might make a big difference in the number of survivors if an attack actually occurred.[8] (To call these the major conclusions of his work is not meant to sweep away the many other aspects of the problem that he treated, or the sometimes acute and valuable and sometimes more controversial results he reached.)

The effort for growth and more effective defenses was not only for air defense missiles. It brought the extraordinary developments of the warning lines, the winged missile (Bomarc), the Sage System, the dispersal of SAC to a greater number of bases, and the extraordinary development of alert capabilities. Meanwhile the threat of modern air defenses against the manned bomber motivated the drive to develop long-range ballistic missiles. The problems presented were so acute that confidence did not reach a very high level in many circles until success had actually been achieved. As recently as 1957 there was still considerable doubt as to the degree of success that might be achieved on the reentry problem, and also a large area of doubt as to the possibilities of accuracy and reliability. Since that time it has become apparent that the technical success achieved has been surprisingly good on all these problems. Also, this was an area in which once again the US was jolted by an unexpected Soviet success, when the Soviets put a missile into orbit before the US succeeded in doing so. This gave a final stimulus to US efforts, however. In public thought the sequence has been marked by the belief in a "missile gap," meaning a marked Soviet superiority, an idea widely held in 1960, followed no later than 1963 by a pronounced conviction that there never had been a missile gap.

In 1959 the idea of a Soviet lead in intercontinental ballistic missile (ICBM) development was so widespread that it could be referred to quite casually. For instance,

> In view of the assumed disparity between American and Soviet missile capabilities, the dangers of a Soviet surprise attack against SAC must be taken very seriously in coming years."

One other problem emerged with all this development. During the decade of buildup and technical advance by the US and Russia, there was constant comment about the effect of attainment of nuclear capability by other nations. In this context "other" meant other than the US, USSR, and the United Kingdom, which although on a lower scale was also a charter member of the "nuclear club." The general tone of comment has always been characterized by anxiety. Minor theories have evolved as to "catalytic wars." According to the theories a nuclear exchange between the US and USSR might be induced by a smaller-scale nuclear attack launched by another country, with the real intention of

triggering the whole hair-trigger system of one or the other two major powers. It was characteristic of some of the thinking in this area, that it attributed acutely irrational or irresponsible attitudes to the government of the "*n*th member" of the club. Since the "*n*th member" is always unidentified, this attribution of irresponsibility to its government necessarily passes without refutation.

It was in this environment, including the early development of the doctrine on tactical use of nuclear weapons in battle and the long-drawn-out tension of the nuclear arms race in both offensive and defensive aspects, that the concept of escalation arose as an offshoot from the main doctrine of deterrence. The concepts of minimum deterrence, flexible response, and stable deterrence were later offshoots. Escalation will be treated in the following section and the other three offshoot concepts in the sections following thereafter.

THE ESCALATION CONCEPT

Content and Structure

The concept or subtheory of escalation is not merely a theory that escalation could occur: it has consistently been put forward with emphasis as a matter to be taken seriously in military policy. Its conclusion is that every effort should be made to avoid using a single atomic weapon, because the first atomic weapon is likely to lead, by escalation, to all-out atomic exchange. To show just what foundations underlie that conclusion the general logical structure will be summarized below. This will of course run the risk of some distortion, but it is believed that the treatment given could be supported by ample evidence from the literature. In the following summary a number of quotations are taken from Halperin, because he happens to have provided a good single source.[10]

The flow of the logic begins with the one new premise, now 15 years old, that the Soviet attains a nuclear capability. The next step is to say that if one nuclear capability is capable of a deterrent effect, a nuclear capability on both sides establishes a matching or balanced deterrent effect. This, however, does not guarantee the peace since, in spite of deterrence, war may occur.

> Because the United States and the Soviet Union have a capability to destroy very large parts of each other's homelands, they share an interest in restraining their mutual destruction in the event of war. It is sometimes argued that this condition makes war obsolete in the sense that we will never have another major war. Demonstrating the necessity for a condition, however, does not demonstrate its possibility, not to say its probability. [Ref. 10, p. 2]

The next component in the structure is the observation that an increase of intensity is most likely to follow a single continuum of tactical or other military application, and more likely to be stopped at some overtly visible boundary line of weaponry or practice. James King, Thomas Schelling, and many others have made comments of some such nature. The general effect is to emphasize that there is a simple continuous gradation from the smallest and shortest-range atomic weapon to the largest and longest range, and that if one side starts using little ones the other side will start using slightly bigger ones or, at any

rate, the use will "escalate." Although more clearly and urgently expressed by earlier writers, this logic has been retained in Halperin's more recent discussion.[10]

. . . the weight of the available analysis suggests that nuclear war is considerably more likely to explode than is conventional war [Ref 10, p 64].
. . . both sides understand conventional warfare, they know that it can be controlled in the present age, but neither understands what nuclear warfare is or whether or not it can be restrained [Ref 10, p 64].
However, even if nuclear weapons are used specifically for the purpose of altering the battlefield tactical war, they will still increase the shared risk of central war [Ref 10, p 58].

The thought appeared to carry over the idea of Wohlstetter[7] that a great advantage will accrue to the side striking first, so that preemption has some value in itself. Halperin[10] retains the idea of swift escalation in preemptive form but apparently imagines a multistage competition and preemption, although a very swift one.

The first time that nuclear weapons were used both sides would feel that an important new dimension had been introduced into the war. Neither would be clear as to what its implications were. Both sides would probably ask themselves whether this meant that central war, either immediately or in the short run, had become inevitable. In this way the use of tactical nuclear weapons in a local war would probably substantially increase the pressures towards preemption and might set off a spiral of preemptive expectations which would lead to explosion [Ref 10, p 64].

Halperin adds one final comment to the effect that "central war," i.e., a general nuclear exchange between the US and Russia, may finally be desirable rather than undesirable, or at least that this cannot be altogether excluded. He therefore suggests that nuclear weapons may be resorted to because their use may escalate, but implies that this would be a carefully selected and deliberate choice.

There may be situations in which the United States would want to introduce tactical nuclear weapons precisely because they increase the risk of central war, but the government should recognize that this is the implication of the introduction of nuclear weapons [Ref 10, p 65].

The general implication of the writers is that if use of nuclear weapons is initiated even on a narrower tactical scale, it will precipitate swift escalation. This is in part, one may judge, due to the background facts of the period of about 10 years ago. At that time the initiation of nuclear warfare in Europe at the tactical level called for the release of tactical Air Force use on what might seem a very large scale and over a considerable area. The capability for tactical use exclusive of tactical Air Force employment was then, and to some extent still is, too small to appear to dominate the thinking, since the Army had only a few gun and missile-type delivery systems available. It seems fair to say that the meaning of the term "tactical use" in the period 1955–1960 was largely colored by this assumption that tactical use would mean hundreds of weapons on targets extending over hundreds of miles of country. At this point a purportedly real condition is implicitly inherent in the argument, although

much of the rest of the argument is of a rather abstract and general logical character.

The next step in the argument is the affirmation that deterrence is mutual, and therefore that the use of nuclear weapons by the US on a tactical or local scale (graduated or extended deterrence as then conceived) has "lost credibility." In short the US must no longer rely on such use to make up for the great Russian advantage in conventional forces for a war in Europe. Although many sources have made statements of this order, two examples may suffice for illustration.

> When the Soviet Union added the ICBM to its arsenal, it destroyed the foundations of American "geo-strategy."
>
> Now Washington was forced to realize that henceforth it could commit itself to the defense of other nations only at considerable risk. And America's allies, aware of the dangers she must be willing to accept on their behalf, began to question the worth of her guarantee. . . . Could the Strategic Air Command be expected to use its weapons of mass destruction on behalf of third parties when to do so meant exposing America to such dreadful reprisals? What became of the indispensable credibility of the American response? [Ref 11, pp 68–69.]

> A balance of terror has now been established in the sense that a resort to a first-strike city-busting or terror attack, directed deliberately at population centers, no longer represents a rational military strategy for either side. Since such a strike would leave the strategic forces of the opposing side intact, it would constitute an act of self-destruction, if not suicide. While cities at a reasonable distance from strategic targets may therefore be regarded as relatively safe from intentional destruction at the outset of a Soviet-American nuclear war, provided the attacker acts rationally, the balance of terror gives no similar assurance that population centers will escape destruction in the course of second or third strikes—once strategic targets have been saturated or once forces capable of taking them out are no longer available [Ref 9, p 31].

It was also argued that European nations were most fearful of nuclear war, to the extent that the threat of nuclear defense would paralyze their will. At the same time the subject is treated as a problem for the US only in an entirely unilateral sense, that is to say the "loss of credibility" argument applies to US policy and decision. The background assumptions seem to be that the US must use some portion of its main strategic atomic capability, and that the US will not, and further should not, engage SAC against anything but an attack on the US itself.

Finally the conclusion reached is somewhat obvious: all plans for the defense of Europe should be based on conventional forces, and the use of nuclear weapons in the tactical battle should be avoided like poison. The conduct of war will be irrational and unreliable at best. Nuclear use, after the loss of nuclear monopoly, must not be the basis of tactical and strategic planning.

> One of the more disturbing accompaniments of the approach to nuclear parity has been a widening gulf between the declaratory and action policies of the atomically armed Western powers. Increasingly we find ourselves bluffing from weakness in the area of limited war, rather than bidding from strength. The situation seems inherently dangerous and unstable. It may have been plausible, in the days before they had nuclear arms, to threaten the Soviets with atomic annihilation as a means (although, in retrospect, a rather ineffective means) of curbing their minor aggressions, thereby saving ourselves the price of more condign means. But this variety of fiscal economy can hardly be afforded in these later times, when atomic parity is fast depriving the bluff of any plausibility it may have had. Conservative planning forces us to assume that when a bluff becomes too implausible it will be called. When it is called, we shall have to retreat from

it ignominiously, accepting some political penalty for permitting excessive divergence of our declaratory and action policies. If we wish to avoid the possibility of such an outcome, we must avoid cut-rate solutions. There is no substitute for military strength commensurate to the military threat. As a means of stabilizing the deterrence of both limited and all-out wars, it seems essential that the Western powers maintain military sufficiency in both areas, not in the area of all-out war alone [Ref 12, p 12].

It is dangerous for public opinion to accommodate itself to peace predicated on a balance of terror and let itself be lulled into believing in its stability. For this balance is essentially unstable, based as it is on such unpredictable assumptions as the mental equilibrium of each of the individuals in a position to upset it [Ref 13, p 14].

Some Critical Observations

In this section a number of specific observations will be offered, partly concerned with what seem to be slippages in the premises or logic of the escalation concept.

The doctrine omits all reference to the relative scale of nuclear capabilities and, by implication, regards this as of minor significance or no significance. This may reflect the degree to which the escalation doctrine grew up in the realm of public discussion and therefore without access or reference to highly classified information on actual stockpiles and delivery means. There are repeated references in the texts to such terms as "when Russia attained a nuclear capability," or to "nuclear parity," and there are very few, until the last year or two, that have taken any cognizance that the ratio of nuclear attack capabilities was anything other than 1 to 1. It might at least be guessed that the weight of argument would be somewhat different if a considerable degree of US superiority were premised, instead of the implied premise of equality.

It may be granted that a difference in stockpiles is not necessarily a significant difference in strategic capability, since if two powers each had reached a level that could be properly characterized as nuclear plenty, it would not matter then if one of them had a stockpile equal to some multiple of the other. Also, if one power has "plenty" it does not matter if another has more, but the ratio matters a great deal if at levels below plenty. Although there is some evidence that the US considers its own stockpile as approaching the level of plenty now, there is no suggestion that any stockpile approached such a level during the 1950's.

Although the literature on escalation argues as if the two stockpiles were equal for all significant purposes, it lacks any examination of what would constitute a level of plenty. It requires only rudimentary skill in analysis to work backward from some moderate number of bombs successfully delivered on all classes of targets through all the factors, for which increased allowances have to be made, e.g., aborted sorties, missiles that fail to function, and losses to enemy defense, and all the varied possible uses to be provided for, including air defense weapons, tactical weapons, and antisubmarine weapons, to show that a level of plenty might actually represent some tens of thousands of weapons all told. It would be at some such level that the consideration of relative scale compared to the enemy stockpile would really lose significance, and further production of weapons, other than by refabrication of outmoded types, might be halted. The important thing is that before the level of plenty is reached the relative size of stockpile remains important strategically. By the same token, until the level of plenty is reached on the inferior side the side with the

smaller stockpile is more deterred from the initiation of nuclear warfare than is the side with the stronger stockpile (assuming only equality of skill in force mix and strategic design).

The literature dealing with escalation omits any detailed analysis of the surprise attack. It requires only a little analysis to throw significant further light. Wohlstetter pointed out that a nuclear attack force disposed in a rather simple manner on a limited number of bases might be wiped out by a successful attack, so that the nation conducting the surprise attack would altogether or very largely escape retaliation and thereby enjoy a winning position. The issue had been a subject of attention even for some time before Wohlstetter's publication, as has been thoroughly well recognized in measures taken since then, including, as already mentioned, the dispersal of manned bombers, SAC alert system, hardening and mobility of missiles, buildup of the Polaris force, and active defensive measures for SAC bases, plus the very elaborate system to provide warning. Surprise has thereby been made a matter of degree with total tactical surprise (bombs on all targets without warning) quite impossible. As of now the maximum degree of surprise that might be attained may be measured by an index such as 0.5 as against the theoretical perfection. What is more, this index of practical surprise attainable will decrease very rapidly, in minutes and hours after initial alert. It will also decrease whenever international tension is sufficient to justify a heightened readiness of the whole system of forces. The degree of advantage enjoyed by the surprise attacker then can be measured by the difference in the effectiveness of his attack as against the relative effectiveness of the retaliatory attack. It might be agreed that there could have been a phase in the development of nuclear capability on both sides at which surprise attack might have been successful and decisive. It now appears more likely that, though there may have been a time when the US could have delivered a decisive surprise attack, there never was a time when the Soviets could have done so. The best practicable surprise attack on the US today would leave more than enough retaliatory capability to deny the USSR any satisfaction or advantage. Surprise attack remains better than any alternative opening of an all-out exchange, but it now appears not good enough; if so, it stands deterred.

> It appeared to most public military commentators in 1962 that in the late 1950's and early 1960's the United States was in such a position that if it struck first it would probably win and might not suffer extensive damage. On the other hand, in retrospect, it appears in 1962 that the Soviets have never been in that position, although the damage that they might suffer now in the event of the central war would undoubtedly be less if they struck first than if they waited for the first blow from the United States [Ref 10, p 12].

The literature on the escalation concept is completely lacking in any reference to the fact that a country deterred from surprise attack must be much more strongly deterred against attack without surprise. Statements as recent as those by Morgenthau in The American Political Science Review[14] completely ignore the distinction between a surprise and a first strike without surprise. Any concept of gradual escalation of nuclear war seems to fly in the face of common sense on this score. If there is a significant disparity in stockpiles and attack capabilities, the weaker much more than the stronger side must avoid any mode of initiation of nuclear exchange other than the maximum

attainable surprise advantage for itself. Escalation would be conducted with little or no tactical surprise against a fully alert defense. The implication is that the literature on the escalation concept accepted the Wohlstetter thesis on the "Delicate Balance of Terror"[7] and failed to note the necessary revisions.

The notion of deterrence is used throughout the literature as if it were a mechanically simple matter. There is little reference to the fact that the technical advances and quantitative scale of nuclear capabilities should be considered properly to make deterrence stronger and stronger with the passage of time. Certainly if US nuclear capabilities in 1950 could deter any power, that power should be far more deterred by US nuclear capabilities in 1964 regardless of any improvement in its own capabilities. The attainment of nuclear plenty on first one side, then eventually on both sides, would not seem to alter this since nuclear plenty inherently means the capacity to destroy the other side in spite of a maximum differential for surprise attack.

The literature on escalation contains little or no discussion of the effect of US policy positions on the structure of its alliances. Hans Morgenthau in his recent article[14] stands as a marked exception; he deals explicitly and harshly with the incompatibility of nuclear monopoly and alliance policy. This is of course simply the obverse aspect of the previous statement that the subject has been discussed as if the US had a purely unilateral problem to consider. The basic premise of an alliance is that the members are in some respects equal in status, and that they have symmetrical relations with each other so far as advice and responsibility for direction are involved. The recipient of aid is, as such, not an ally but a satellite. A recipient of one-way advice also is not, as such, an ally; neither is the giver of such one-way advice. The US, under the impact of events and with its primary decision amounting to unilateral trusteeship of atomic technology, mitigated only for the United Kingdom, has tried to have alliances based on asymmetric relations. This is not to say that the asymmetries can be washed out; it is really only saying that some problems of adjustment and compatibility have to be recognized, and the US cannot expect to conduct its alliances with its right hand while it pursues unilateral policies with its left hand on related matters, as if the two areas had nothing to do with each other. This does not require us to agree with Morgenthau's pessimistic views on our alliances, but remedies will require fundamental clarification of the alliances in their structure and significance.

On the key subject of the size of the American nuclear capability, there is now much more public information than there was even a fairly short time ago. Secretary Gates and Secretary McNamara have repeatedly asserted that the US is not simply equal to the Soviet in atomic capability but considerably superior. Mr. Khrushchev did not explicitly endorse this view but offered the world the concrete statement that the US has 40,000 weapons. This has begun to remove some of the blank obscurity on the matter of relative scale. But for nearly 15 years the rest of the world, including the American public, was kept in a state of ignorance on this point. The ignorance can be measured by the fact that very intelligent and able writers wrote for a decade as if the US and Russian capabilities were equal to all intents and purposes.

An observation was made by Mr. Goren in an entirely different field, which, however, might seem pertinent. Discussing a bridge game in which a player outsmarted himself in order to conceal the location of a card, it being obvious

from the bidding where the card lay, Mr. Goren remarked, "Gladly reveal to your adversary that which he already knows about your hand."[15] Goren did not add the obvious corollary, "Reveal to your partner, at least grudgingly, what your adversary surely knows."

The proposal to reduce or limit reliance on atomic tactics and restore reliance on conventional forces is repeated in many forms. Certain of the logical consequences are, however, neglected. One obvious consideration is the sheer vagueness of requirements for conventional forces. The estimating of military requirements has become more and more technical and systematic in form in the last 15 or 20 years of research and analysis of military problems. However, the crucial features of any analysis are its data and assumptions, and some of its assumptions concerning logic. The estimates for forces required for strategic stability are rather firm and stable in some areas of military calculation, especially in such problems as the required scale of the British fleet to encounter the German fleet in the early part of this century, or the required quantities of aircraft in former conditions of air warfare. Applied to ground forces, however, an objective observation is that the required scale of conventional forces in a given area varies by something like a factor of 2 or more according to who performs the analysis. This has held true in the case of NATO Europe, where one can get numbers ranging from about 24 divisions up to about 50 divisions (fully ready) as the requirement for safety. This happens to be exactly the condition most favorable to an arms race, since the establishment of a ratio that seems satisfactory to both sides is almost impossible, psychologically or mentally.

It was formerly a worry that the buildup in strength in Europe might bring into play the logic of preemption, and motivate Soviet attack. Any such worry has of course by now disappeared with the passage of time, since by far the most favorable opportunities for Soviet seizure of Europe, in a supposititious nonnuclear war, have long passed.

The literature on escalation has also tended to omit reference to the deep-laid antipathy in Europe against any major conventional war. The allegations of European fears of nuclear war have been written as if conventional war would be much more acceptable. Actually, of course, Europe has now been the scene of two very great wars called "conventional" more by us than by them. The effect of the wars is so deep in the European consciousness that the old extreme nationalism has given way to such developments as the Common Market. At any rate this question would be worthy of examination: Would European morale really benefit by an assurance that war in Europe would be conventional rather than nuclear, even if, therefore, more likely to occur?

Further in this connection it may be observed that European powers, most conspicuously France, so far as evidence goes, but with some indications that Sweden has the same attitude, are rather more anxious to join the nuclear club than to turn their backs on nuclear technology and nuclear weapons. Snyder remarked on this but qualified his remark with a reference to the credibility issue.

> Yet the Europeans do not embrace the logical consequence of this fear: the need to build up an adequate capacity to defend Europe on the ground. A more favored alternative, at least in France, is the acquisition of an independent strategic nuclear capability. But when European governments project their imaginations forward to the day

when the enemy's divisions cross their borders, do they really envisage themselves shooting their few missiles against an enemy who would surely obliterate them in return? [Ref 16, p 7]

Although the idea of nuclear escalation has been emphasized, though with little technical analysis, there is complete neglect of the kinds of escalation that can occur and have occurred in wars without nuclear weapons. Several observations can be made. WWI and WWII escalated in terms of participation; in terms of the intensity of economic, logistic, and combat effort; and very markedly in terms of mass psychology. However, also, the nature and reliability of the back pressures that check some of the kinds of escalation that would otherwise be imagined could also be analyzed on the basis of the history of past wars. This is the kind of study area on which the demand for the results is less readily established, and the processes of programming research are not very conducive in or out of government. At any rate, nonnuclear escalation represents a void in the body of developed knowledge, but not a necessary one.

In WWI there was a sequence from extreme national effort within conventional assumptions about the nature of war, followed by acute disappointment when the inevitable victory remained remote; and escalation into such new and then radical means of warfare as gas, submarines, aircraft, and tanks. There was an extraordinary escalation of psychological warfare also, and this, as was well discussed by Hoffmann-Nickerson long ago, translated the war of mass mobilization into a war of mass emotional intensity, with an escalation of the war aims toward something approximating unconditional surrender. Such historical matters might well be held in mind, particularly in connection with Halperin's argument that conventional wars can be limited. Certainly the last one was called a total war rather than a limited war during its term. Further it may well be observed that limitation or totality rests finally on mental and philosophical conditions in the minds of the participants, and limitation is not easily established on that foundation. Any limitation in terms of types of hardware is likely to prove fallacious if not accompanied by mental and emotional restraints.

The literature on escalation refers constantly to the "loss of credibility" that the US will actually apply nuclear force in the war on another continent, in the face of the risk that this will bring nuclear attack on the US itself. The argument is legitimate in itself, though one need not agree with the conclusion. However, such an argument should be applied with rational consistency, if at all. The loss of credibility in American intervention should then be examined in the light of the continuing, or the lost credibility of Soviet aggression. Also, lost credibility is in some sense a subjective term having reference to what people think. In this case the important people, i.e., the people whose thinking will shape the events are the Soviet leaders who will decide to invade Europe, or not to invade. In the light of all the last 15 years of American policy and NATO development, it might plausibly be stated that the prospect of success in a Soviet invasion of Western Europe, while American forces abstain from using nuclear weapons, has "lost credibility." The object of policies of deterrence is precisely paraphrased thereby.

In part the literature also often resorts to an argument in the form "what if . . ." The characteristic of this form of argument is that it introduces some possible but unanalyzed and uncriticized possibility in refutation of some

otherwise fairly strongly established proposition. For instance, when the argument for deterrence has been put, and appears conclusive if the enemy is assumed rational, a quick and easy refutation is in the form of "but what if they are irrational?" On this it would seem that the level of criticism has not been as good as it might be. The argument might well be identified as a move of "gamesmanship" character. Objectively examined on the merits, the "what if . . ." type of argument generally deserves far less credit or weight than it is often accorded.

At least in some of its forms the escalation argument approaches the point of preferring an assured conventional war to an only remotely possible nuclear war, or at least a much more likely war, nuclear weapons barred, to a much less likely nuclear war. Halperin notes that even in 1954 ". . . the critics . . . stressed the dire consequences should the threat of massive retaliation fail to deter and tended to ignore the possibility that it might work" (Ref 10, p 4). The counterargument could be put, though it has not been put vigorously, that the surest way to run the risk of escalation is to let a war start. Letting any major war start surely will reduce the chance that any clever analytic scheme for its limitation thereafter will prove effective. The maintenance of conventional limitations may lose credibility when either side initiates an apparently successful offensive. Limitations may be maintained quite firmly as long as it appears that neither side is threatened with a great strategic loss. By the same token the war may be unlikely to escalate on exactly the conditions on which it should have been deterred from even starting. A nonescalating war in fact should not have started in the first place. If those who worry about escalation took cognizance of this, they might restore some of the confidence in deterrence that they excluded. In past wars the loser has consistently resorted to every kind of escalation that offered a plausible prospect of advantage—but not those forms that would only lead to a worsened outcome.

In some more general ways the escalation argument tends to run in circles. Deterrence will fail because the threat to use nuclear weapons under certain conditions will be a bluff unsupported by firm will, and the bluff will be called. Calling the bluff will be successful. It then is passed without notice that nuclear deterrence has been accorded a very high value. In fact, deterrence is so powerful that the defending side is altogether deterred from using nuclear weapons. The question is at least begged, if deterrence can have so powerful an effect as this, why can it not in fact be used to deter the aggressor. The answer would be simply that it could be so used if will were firm enough, and the real major premise is that the will of the defending side will not be firm. It cannot be proved that this is incorrect. But one thing is obvious. It is exactly the mechanism that brought on WWII through an appearance of lack of will on the part of all the powers opposed to German and Japanese expansion, and it was not a successful means of avoiding escalation.

There is one alternative premise; war will occur, not because one side is convinced that aggression will succeed, but in some one of the innumerable possible forms covered by the terms "accidental war" or "catalytic war." The events of 1914 may stand as somewhat favorable evidence. The real strength of this argument is not in any clearly realistic basis, however, but rather in its lack of specificity, which makes it so hard to refute. The 1914 war did start without any planned intention that it should start as it did and when it did, only

as a precipitation of events, with all the cards stacked in such fashion as to permit the full-scale engagement. The necessity for swiftness of mobilization was a major consideration in the crucial week from the first shooting to the entry of Britain. But to imagine any of the individual countries of Europe starting a small war that escalates to a large one again is to overlook a major condition of the historical case; nobody in 1914 had any foresight of the consequences. Nobody today can lack the hindsight. History can be repeated, it is often pointed out by those who forget it; it is precisely impossible to repeat great fiascos if they are well remembered.

For mutual deterrence of nuclear use finally to stand as a license for conventional war, it is necessary for the deterrence of nuclear use to be so strong that defeat in conventional war is preferable to nuclear use. If this is not so, then a conventional victory-defeat outcome in conventional war is excluded. If so, conventional war itself is deterred, and nuclear deterrence is restored as a principle. It is only the threat of nuclear use that would restrict conventional war to outcomes less than victory or defeat, and thus deter it. If it is true that to resort to nuclear weapons would be more terrifying than defeat, there is need for an elaborate analysis to prove that both sides can convince each other that this is so. Alternatively there can be a one-sided situation in which one side would evidently accept defeat rather than use nuclear weapons, creating the opportunity for the other to simply refuse to share the posture. The side that refused to share that posture could automatically impose its choice of conditions. In short, mutual deterrence of nuclear use appears to lack any stable foundation unless related to deterrence of war.

MINIMUM DETERRENCE

Among the class of theoretical offshoots of the general body of theory about nuclear war is the theory of minimum deterrence. It has not generated as much attention or as voluminous literature as the escalation concept. It requires mention, however, because it is a semi-independent entity in its own right. The landmark writing on the subject was by Backus.[17]

The concept amounts to this. Destruction can be inflicted on any nation on so large a scale as to make any war aims fruitless, by delivering a number of weapons far less than implied by the capabilities that were being developed. Instead of playing around with elaborate schemes for tactical or more humane methods of nuclear warfare, a simple and firm commitment to wipe out enemy cities in mass should suffice to create a firm deterrent.

The argument has one great weakness. It entirely overlooked the enormous redundancy required to allow for all the effect of enemy defenses and progressive technological advances in such defenses. The assurance of inflicting the minimum sufficient damage to deter, in short, requires very large markups of potential capability. Correspondingly the scale of markups is an area far more ramified and therefore far more controversial than is the simple concept of an adequate quantity of weapons finally delivered with success. In addition the argument overlooks all the possible requirements of extra allowances for use against other nations than the two main antagonists and of uses for air defense weapons, naval weapons, and other complicated features of the total situation.

It had some degree of merit. The design of nuclear forces is a sufficiently complicated subject to afford numerous options, and it is obvious that the power with the largest stockpile and the largest economic resources can afford to make some choices in ways that other powers cannot afford. The optimum choices for the strongest nuclear power are not identical with the optimum choices for the second and smaller nuclear powers. The power with the second biggest stockpile may very well choose to produce a mix of weapons containing a greater proportion of very-large-yield weapons and a smaller proportion of smaller-yield weapons. Judging by the public information, which may of course be distorted, Russia has made exactly such choices to get the most capability and the most deterrence from a smaller stockpile of materials.

However, the theory shared to an acute degree a characteristic that is exhibited by some of the rest of the literature. Herman Kahn properly observed that it is a theory "for an expert who wants to look good to other experts."[8] (in his "Three Lectures on Thermonuclear War," presented to many audiences.) Good critics, it may be opined, could find much to criticize, not only in the theory of minimum deterrence but throughout the literature in arguments of an abstract and technical character that would apply, perhaps, in a world ruled by analysts but scarcely in a world where analysts are outsiders to the main stream of politics.

FLEXIBLE RESPONSE

One other identifiable subtheory is that of flexible response. Its content has remained somewhat vague, at least to the degree that one may find it hard to differentiate entirely between the idea of graduated deterrence and the idea of flexible response. In part it seems to propose that situations in which massive nuclear retaliation may be an excessive measure should be subjected to deterrence by an adequately strong conventional defense. In part, however, it also implies a concept that has never been made altogether clear. This is substantially that in many parts of the world there are conditions of human society and policy such that the occurrence of war is rather to be expected than not. The historical conditions are such that the causes of war are present, and the occurrence of war must be taken as more or less natural. Some such situations are of such local character that they do not, as a war for Europe might, imply an unacceptable defeat for one of the major powers. At any rate, it is implied that such conditions exist, and that a considerable time interval may be necessary before, if ever, they can be subsumed under the system of deterrence or of a peaceful world order.

There certainly are observable situations in which human violence is either manifest, or latent and threatening. Such conditions apparently have existed on a considerable scale in the back areas of Colombia, for instance, and in many parts of Asia and Africa. The strongest proponents of nuclear deterrence offer no pretense that US or Soviet nuclear weapons can be usefully applied in such situations. With or without a claim that the reliance for the defense of Europe should be primarily conventional, or primarily nuclear, there remains an element of truth that a requirement for conventional forces, without nuclear weapons, still exists and will continue to exist for real or potential situations ranging from Cyprus to the Congo, Southeast Asia, and some areas in Latin America.

DOCTRINE OF STABLE DETERRENCE

The fourth principal subtheory is that of stable deterrence. This evolved in the period just after the alarm about "The Delicate Balance of Terror."[7] Examination of the technical possibilities rapidly revealed that the balance of terror need not be so delicate. The major requirement was to exclude any decisive advantage to a surprise attack. This concept or theory has been rather less explored in the public literature than some of the others treated previously but has had obvious firm acceptance reflected in the massive programs of development and procurement. The turn from manned bombers to missile weapons for delivery and to more sophisticated defenses has been oriented more and more toward eliminating any decisive advantage to a surprise attack, thus assuring the vast destructive effect of a second or retaliatory attack and tending to make deterrence far more stable.

The lack of exhaustive analytic attention to the theory has, however, left a void concerning its applicability in graduated form. It is therefore appropriate to sketch in brief outline the possible concept and matching posture in real terms, which might provide both stable and graduated deterrence.

The first principle must be the one already established, i.e., the capability to inflict disastrous retaliation even after a surprise attack of maximum success must be assured. If all-out exchange cannot be deterred, escalation of course will be the rule. The absolute assurance of adequate retaliatory attack is not as easily established as implied by the "minimum deterrence" argument but nevertheless appears quite feasible.

The surprise attack may be in either of two forms, (a) a precision attack against the bases or installations from which a retaliatory attack must be launched, or, quite within the capability of modern nuclear forces of the US and the USSR, (b) it could to a considerable extent be without precision and simply be an obliterating attack to wipe out everything vulnerable within a whole area. If the installations for offensive nuclear warfare were of exact known locations and vulnerable to the effects of attack within the accuracy of attacking weapons, they could be wiped out. At the same time, if their locations were unknown, except that they were known to lie within an area that could be wiped out, they could be annihilated by area attack without precision. The answer to precision attack is available in three forms—hardening, concealment, and mobility—all three forms are being used. The answer to area attack is also available. Although the US or USSR nuclear capability could obliterate all but highly hardened sites in an area as big as many other nations, it could not do so for the entire area of continental US (CONUS) or Russia. In fact, given all the factors involved, there is no prospect that any nation could produce or afford in economic terms a nuclear attack force capable of annihilating all the area available to the other side in so short a time as to prevent effective retaliation. The cost of a nuclear delivery force in being is comparable to the cost of a weapons stockpile, or greater, and unlike the stockpile this cost must be paid repeatedly for modernization. This restricts the maximum destructive potential that would otherwise be unlimited. The threat of area attack is reduced still more when it is considered that the US through its alliance may be able to arrange dispersal of its retaliatory forces over areas far larger than CONUS, and through the use of the Polaris force can make use of still greater areas of the ocean that lie within Polaris' range of potential targets.

These concepts are well recognized as applied to the forces earmarked for the central war or all-out war. But what has not been noticed is that starting at the lowest level of tactical nuclear weapons, the criteria can be established, and that no matter what recourse the enemy has, the capability of retaliation will be retained. One can posit that the enemy could wipe out the American capability in the lowest-scale tactical weapons, guns or short-range missiles, either by precision fire or by mass-area fire. The mass area involved may be well within the capability to annihilate. It may be taken as an area 20 miles deep, 50 miles deep, or 200 miles deep on a front having the length of the front across Europe. The number of large-yield weapons required to destroy all nuclear launching capability in such an area may be within the presumptive capabilities of the US or Russia. However, a graduated series of types of delivery systems, varying in range and yield, can be established, such that if any lower level is wiped out by area attack, or precision attack, if this is possible in the premises, another layer remains fully able to retaliate.

Such a system denies any expectation of decisive success through any form of surprise attack, no matter how successful. It will remain true that surprise attacks offer the maximum advantage that can be attained, and that any advantage practically attainable without surprise will be less. If the level of advantage accruing to surprise attack is not enough, it will always follow that no scheme can produce more satisfactory results.

The scale of establishment required might be set as sufficient tactical nuclear capability to deny a tactical conventional success. Such tactical conventional success may be taken, by the experience of history, as meaning a radically successful victory in battle, such as occurred on various occasions in WWII, with a breakthrough followed by deep penetration and with great strategic payoff to the victor. The nuclear means of "coppering the bets" on such tactical effects should be provided in the most restricted form feasible, and this is presumably being done in the form of Army types of nuclear missile, for instance. Since the first layer cannot be secured against area attack by itself, it has to be backed up in echelon by weapons of a longer range to utilize an area too large to annihilate. The weapons chosen for any occasion should be the smallest yield and shortest ranges compatible to the effect required, to avoid any appearance of a threat of strategic attack on the enemy nation. Targets should be selected as close as possible to the front, though this may require an attack on logistic targets to a depth of 10, 20, or some other number of miles, and the real requirement may be controversial and difficult to settle. The important thing must be that, whatever means the enemy chooses to secure his conventional success, there may be recurring use of nuclear weapons to deny his conventional success. If by either precision or area attack on his own part he eliminates our shorter-range weapons, we must be able to fire weapons from a greater depth but still at the same class of shallow targets. In short the capability of delivering nuclear weapons on enemy forces at the front must be available to a depth of hundreds and eventually even thousands of miles, so that neither his precision attack nor area attack can eliminate it. Then, if the US were to initiate nuclear use to deny enemy conventional success, the enemy could face and examine the prospect of escalation and find that there is simply no stage of escalation that would offer him any advantage. In short, deterrence would have a resilient and stable nature, tending to deter him from any and

every choice of a step on the ladder up to and including the top step, and down to and including the bottom step. The condition of stability, against the condition of "delicate balance," would be provided all the way. There are no technical difficulties about this.

The number of different types of weapons, extending from the smallest and shortest range to the biggest and longest range, might be as many as five or six. Thus for a convenient system of graduated stable deterrence the US might require Army delivery systems of say 10, 50, and 500 miles range, together with another weapon of approximately the range of Polaris or a missile of the approximate range of the older Jupiter or Thor. These of course should be backed up in turn by the all-out force, in the valid form of Polaris, Minuteman, etc. The numbers required would of course be subject to the calculation of minimum requirements plus necessary markups for factors of safety and redundancy. However, an extremely formidable establishment along these lines would not seem to require a total quantity beyond the feasible scale. Such a system would emancipate graduated deterrance from the old flaw that affected extended deterrence. It would not involve commitment or compromise of the force earmarked for all-out war or imply the acceptance of attack on USSR and US cities.

The quantities of weapons, yields selected, and means of launching cannot be discussed in very much detail on the basis of unclassified information. However, at least this much can be said. Taking such a front as that from the Baltic to the Tyrol we have a distance of 750 km, or from the Baltic to the Adriatic we have just about 1000 km. Fairly low- (not very low) yield weapons spaced 1 km apart would inflict very serious destruction and lethality effects from one end to the other of such a front. Larger yields, possibly as high as 1 MT, might be found necessary or suitable for use on target areas slightly farther back from the front, as required for safe distance from one's own troops. Such weapons could establish a solid band of destruction, up to any given criterion that might be selected, such as blast pressure of a certain intensity or immediate radiation. The numbers of such larger weapons would be progressively less, in proportion to their increasing lethal radii at any given measure or criterion of lethality. Some parts of a front are not tactically usable for an offensive operation, and hence some portion less than the entire front may require an atomic barrage to interdict an effective conventional offensive. Some portion of enemy forces can concentrate in the very close frontal zone to take advantage of the safety distance allowance in our targeting with atomic weapons, but our smaller-yield weapons leave far too short a safety zone to permit the mass of forces to escape by this means. If then the capability is present to fire a solid band of atomic "lethal areas" the length of the front, in each of several grades of weapons, with ability to repeat the performance, from a base of fire so large for the longer-range weapons that the enemy could not wipe it out even by exhausting his own stockpile, it would appear to be physically feasible to prohibit his conventional offensive success. Also it would appear logical to apply the lowest scale of atomic use that would appear to be enough in the given case.

The system would carry a by-product benefit to the overall strategic deterrent. It would possess a considerable capacity for strategic attack, which could be applied if all-out attack were to come first rather than by escalation. The enemy, to assure himself of adequate success in a surprise all-out attack,

would have to deal not only with the US forces for all-out exchange, but with the whole system. It would water down or dilute, by simple extension of area, the impact of enemy attack and would multiply the number of specific targets requiring destruction for enemy success. It would avoid, rather than seek to establish, clear distinctions between steps in escalation and would rely simply on firm deterrence at the bottom with no weakness in the deterrent logic.

The limit on the scale of cost and effort would remain as before, the condition of nuclear plenty. Although estimates of the level of "plenty" could be expected to be controversial, there could be some limits set by reasonable practicality and prudence. One may judge by the stretch-out or slowdown of AEC production activities, which has been made public gradually over the last few years, that the US considers that it is approaching the level of nuclear plenty rapidly enough to reach it before the USSR can do so. Plenty, in terms of a graduated stable deterrent, will not immediately imply larger scale and cost. The delivery systems for weapons of shorter range are cheaper than those of longer range and require matching enemy provisions if the enemy is not to accept deterrence without challenge. A stable graduated deterrent may not be substantially cheaper than a stable deterrent for all-out war only, but it does not appear that it will cost as much as a nuclear deterrent of nuclear war only, plus a conventional deterrent of conventional war.

The mode of use, if war occurred, could satisfy the condition of deliberate response. Given deterrence of surprise attack, the reluctance of the enemy to escalate could be viewed with confidence. If he is not reluctant, some terrible mistakes have occurred. The doctrine should simply be to use nuclear weapons only as necessary, but no less than necessary for the limited effects required. There would be no impulsive pressure to fire for fear of being too late. The objective has to be quite clear—to deny the enemy any major tactical success leading to strategic success. If stretched to threaten a major offensive success against him it would restore the risk of escalatory exchange. Only on such conditions, with well-established capability and equally well-established doctrine, can deliberation be maintained. In the premises the purpose must be to deter, not to invite a war and win it.

There would be many technical details to settle and many requirements for measures to make the situation clear to the enemy. The first essential is that the first step in nuclear escalation must be understood as the capstone to enemy conventional escalation, but with no more to follow unless the enemy makes the mistake of escalating. The enemy must understand clearly that to escalate is a mistake and to abstain from escalation is not a mistake.

Among other things, this will deny to the enemy any strategic bargain sale. Alternatively the US commits itself to both an adequate nuclear posture and an adequate conventional posture. Given the advantage of relatively superior secrecy, this opens the option to the enemy to provide himself to some degree with one or the other and not both.

The system of graduated stable deterrence would also be one to which the structure of the alliance could be adapted effectively. Given US conviction as to its logic, the US could eliminate the weakness pointed to by the "credibility" argument. Assurance of firmness of will on the part of the US would at the same time eliminate the one great argument of de Gaulle for his independent "force de frappé." The accumulated evidence is rather strong that the NATO

powers would in fact welcome such a posture more than they welcome the idea of trying to equal the Soviet conventional forces.

The central premises involved are more apparent after outlining the concept than they are at the beginning. The concept rests on the assumption that war can in fact be deterred by the establishment of powers of destruction disproportionate to the objectives that might be sought in war. It assumes, in short, that deterrence is feasible and can be both graduated and stable. It would build graduated deterrence from the bottom up, not only from the top down. It accepts the evidence of WWI and WWII that there are powerful forces of deterrence even without nuclear weapons. It accepts the long, well-founded premise that the continent of Europe is a stake too great to be treated as a case of limited war. It provides a basis on which the alliance could be given a more stable and reasonable form, and it provides a basis on which the enemy and allies alike could be given credible assurances of the reliability of the US. It would remain subject to the qualification pointed to earlier in the discussion in the section "Flexible Response," that in other areas of the world it would not be readily applicable. But it would find in a retaliatory system secure against surprise attack the premise for strategic stability that has been refused by the enemy in the long-sought alternative form—a treachery-proof inspection and control system. Its establishment would be a most favorable condition on which to begin progress toward the other and more rational basis for stabilization.

SOME BY-PRODUCTS AND MAIN PRODUCTS FROM PAST IDEAS AND ACTIONS

There are quite concrete elements in the present situation that derive in considerable part from ideas that arose long ago. The results of past ideas are not confined to simple and logical consequences; sometimes a single idea may arise as the consequence of a controversy, rather than as the consequence of one side of that controversy.

One of the effects of the "credibility" argument was that, in at least one sense, it needed only to be mentioned to become true. As soon as American books and articles began to talk about it the French and others knew that the Americans had raised questions, and the credibility had only to be questioned in order to be, to some extent, discredited.

Credibility is not the only older thought having present consequences. The unilateral posture of the US in terms of nuclear power, together with unresolved discussion of how to establish NATO nuclear forces, etc., has presented the whole situation to governments of all countries in such a guise that they might be inclined to consider dissociating themselves from nuclear war altogether or alternatively seeking a nuclear capability of their own. The dissociation of other countries in nuclear war tends to reduce the area that the Russians might have to attack and is not helpful to American calculations.

Only if the Western allies could provide a single united pool of targets for the enemy is there a maximized deterrence. Any reduction in the pool of targets the enemy has to attack improves the advantage of surprise attack and makes the deterrent effect a little bit less. The unity required for this perhaps has to be greater than that for an ordinary alliance. It may mean some

sort of guarantee to each member, not only that no member will secede from the group, but that the alliance will abandon none of its members. Buchan's treatment represents one tentative effort to solve this problem.[18] The approach of Gallois[19] likewise represents an effort to find a solution. Despite whatever is unsatisfactory about the solutions as offered, they stand as efforts to solve the right problem. The rejection of their solutions, if they are rejected, should not mean abandonment of the problem but the necessity to offer a better solution.

A by-product of a different sort may be found in the expressed attitude of the Chinese communists. They, even more than the French, seem to have taken the credibility argument too literally and to have concluded that US nuclear power is a "paper tiger." So far as this has contributed to open the fissure between China and Russia the results may not have been lamentable. So far as it may have encouraged Chinese aggressiveness the results may not yet have been measured.

Such by-products of the development are very far from constituting the whole picture. Any analysis of the intellectual movements or trends on this subject tends in part to overemphasize their importance, because they emphasize so much just those trends that produce the most provocative expressions. It has already been suggested in many foregoing points that the physical and political aspects of the development have been going along to some degree independent of the intellectual evolution. Also the research and development and the development of force capabilities to some degree proceed in their own massive manner, expressing themselves in actions with their rationale obscured or concealed. Among the main features of the situation today that have developed from all the course of thought and action of the past 15 years or more are the following:

(a) It seems now an agreed matter of fact that the US stockpile is very significantly larger than any other and that the process of producing this accumulated stockpile is one requiring such massive resources that no country can readily change the situation by any act of policy.

(b) The US stockpile cannot be matched by any nation or combination of nations in any few short years. The actions required to produce this US stockpile have been taken without any wavering, in spite of all controversies concerning deterrence or other aspects of the problem.

(c) The strong US posture extends to great systems of offensive and defensive military forces in which the accomplishment, as with the stockpile itself, implies no wavering or indecision.

(d) The US has gone ahead with the technical development of tactical nuclear capabilities and, at least to a considerable extent, has provided the basis for actual use, i.e., delivery systems, etc.

It appears on the face of events that the US is confident of attaining nuclear plenty, i.e., a level at which the ratio of other stockpiles to the US stockpile ceases to be a matter of concern, before any other power can attain such a level. It will attain that level before the Soviet Union, and there seems no occasion to doubt that the Soviet Union will attain it before the United Kingdom, France, or any other "nth member" of the club.

The USSR has not elected to initiate any major war, and there is little evidence that they are at all inclined to consider such a gambit. If this does

not prove that nuclear deterrence has worked so far, it can be only because they might have made the same choice even in the absence of nuclear technology.

The immense practical power and influence of the US in the world certainly is greatly amplified by the existence of nuclear technology. The US can readily apply great destructive power or military influence anywhere in the world, without the delay and the labor of years of war mobilization.

A FRESH AND COMPREHENSIVE REVIEW

This paper is only able to suggest many matters that are worthy of the most thorough-going study. Some of the numerous books on nuclear war strategy contain the results of vastly greater research effort, confined to small segments of the whole problem area.

However, it may have served to state and underline a few much neglected points, which may be as important as is here argued. To recapitulate:

The processes of intellectual history, even on such a subject, are not altogether well disciplined or logical but share the common characteristics of the history of thought. The bodies of thought and theory that are produced can contain elements of fault or error ranging from the simplest semantic slippages to the broadest emotional bias and prejudice. Some features of this thinking have had, or at least could have had, damaging rather than constructive influence on further policies and developments.

In the course of public discussion, some of the techniques of logical criticism have been applied only in a biased way, as is most readily shown by the fact that they have been applied to refute one argument and have not been mentioned in relation to another argument to which they have equal or superior relevance.

Several elements in the American posture may deserve careful reconsideration, now or in the future. Among these is the tendency to unilateral posture, which carries overtones of the old isolationism. The policy of secrecy has at all times been more discretionary than absolute, which was of course absolutely necessary, since there can be no deterrence if the enemy is kept completely ignorant. However, there is some evidence of damaging results in American public opinion and public opinion in some allied countries, because of lack of information on major facts.

In spite of all divisions of opinion the all-important things have been done, and the worst view of the faults would, it seems, have to admit that the faults have been secondary compared to the enormous accomplishments. The whole situation vis-à-vis the enemy, the allies, or the rest of the world has in no respect become irretrievable.

A serious revision of American theory and doctrine on nuclear war would be quite difficult. It would require an extremely well-organized and rather long-drawn-out effort to identify, rearrange, sort out, select, and discard from among the facts and assumptions, on the one hand, and to review and reconstruct the logic on the other. Many factors would weigh against the undertaking of a systematic review on the required scale of effort. Efforts of the sort do occur over time, some of which have been cited in this paper, such as the **Finletter Report,**[5] the Acheson-Lilienthal Report,[3] etc. Very few of them had

to grapple with the whole product of 20 years of energetic theoretical growth. Also, since the policy is wrapped up with organizational and institutional commitments and procedures in the Executive Branch, Congress, and to some degree with other governments, the resistance might well be expected to be both more widespread and more intense than the motivations for such a review could be. Such a review, if it were made, might discount considerably the weight and value that have been given to the escalation concept and tend to clarify and give greatly added weight to the concept of stable and graduated deterrence. Actually the trend of events seems toward the concept of stable and graduated deterrence, rather than against it. As in some other human activities, some accomplishments get done without a theory, and some apparently influential theories pass without substantial effect. The argument of this paper can be summarized finally as follows:

The concept of the defense of Europe by nuclear means was first thought out in the early 1950's when the means available imposed the logic of the critical advantage of surprise, the emphasis on "counterforce" strike, and the impulsive logic of "he who hesitates is lost."

Since that time the development of nuclear delivery means only moderately vulnerable to surprise attack entirely alters the logic; a concept of deliberate nuclear use to deny conventional success can be divorced from the former concept of impulsive fire and a "counterforce" character (in the counter-nuclear-force sense).

The concept of escalation was a derivative from the complex of ideas that had some relevance in the early and mid-1950's. A properly designed nuclear force system and appropriate strategic concepts for the late 1960's would remove all the structure on which the escalation concept was dependent.

The concept of stable and graduated deterrence, with use only on a deliberate and controlled basis, should replace former doctrine.

IMPLICATIONS FOR ARMS CONTROL

The scheme for graduated stable deterrence sketched above would not contribute directly toward early and practical measures for arms control and disarmament in Europe. On the face of it, such a posture would link graduated deterrence, from the bottom up, to the status of the nuclear forces earmarked for all-out or "central" war. They would be maintained in sufficient capability to assure deterrence.

However, the clarification of the situation would be considerable. The capability to outdo the enemy in escalation at any stage would be established as a hard fact. The intention to use this only to deny strategic success, not to try to attain such success, would be forcibly implied by the link to the deterrence of all-out exchange, taken as mutual. The acceptance by both sides that major war in Europe is in fact deterred would be put on a much more convincing basis. The basis for effective policies for the NATO alliance would be much improved. The credibility of US intention would be restored, because the conditional US action commitment would make good sense.

This of itself would create a new basis on which to consider the minimizing of the necessary forces on both sides (not the same as "minimum deterrence").

It would establish a basis for forces, doctrines, and policies that would minimize the risk of escalation by minimizing the risk of war and excluding the possibility of conventional success. It would permit a much more definite conception as to the quantities of conventional forces needed for strategic stability in Europe.

The net effect might be little or no reduction in the scale of effort for security, or aggressive capability, now made on each side. It might, however, tend to reduce tensions very considerably, with substantial beneficial effect in areas other than the restricted one of defense of Western Europe. It would tend most strongly to set a limit on any arms race in Europe, on the scale at which "enough is enough." That scale might be no greater, in terms of aggregate cost, than the scale of present programs. The difference would be that this scale would be clearly stable and not subject to competitive increment.

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The Effects of Technical Innovation on the Nature of Politics

ABSTRACT

Technical innovation has occurred in several different modes in the course of history, with the modern exact sciences as the now classic type. A new form is emerging, the extension of analytic logic and mathematical tools beyond the scope of rigorous laboratory technique. The impact of technical innovation on politics has been through several different causative paths, with differing effects, but mainly representing the indirect action of obscure social forces. The effects on politics have remained indirect, and the major adaptations in politics have been those of an empirical art. The newest extension of the scientific style beyond the exact sciences promises new direct and important effects on politics.

CONTENTS

INTRODUCTION

The first question of the age is whether innovations in political processes, in response to the consequences imposed by technical innovation in other fields, can be brought into an orderly phase.

To discuss this question or subject, we have to identify at the beginning what we are talking about, i.e., what we may mean by technical innovation within the broader area of innovation in general, and what we may mean by politics.

To specify the general effects of technical innovation on politics we have to observe a wider area. If we did not, we could not isolate the effects due to one class of causes from those due to other related causes.

The flow of innovation and the system of politics both vary in character from one historical period to another, and if this is not observed, all sorts of slips can arise in judging the effect of one on the other. Hence to come to grips with the issue we must take a broad area and a long time span.

TECHNICAL INNOVATION

Innovation of a technical nature arises as discovery or invention of many different kinds. The main types in our minds are:

(a) New knowledge or new science (as originated by Galileo, Newton, Faraday, Darwin, Einstein, Planck, and others).

(b) New applications and products (electric light, radio, TV, automobiles, and computers).

But other innovations are also important:

(a) New productive systems (the "industrial revolution").

(b) New areas of advance of knowledge (biology and psychology).

(c) New schools of thought (physical science in general and cybernetics).

These enter the culture from several kinds of sources. Basic discoveries come from rigorous science. Applications or inventions come from the area of engineering technology. New productive systems arise from the interaction of technical and economic activities, in such complex ways that we do not clearly plan or state them before the fact. New areas of the advance of knowledge develop out of complex workings within the community of science and on its fringes. New schools of thought arise on the intellectual planes where scientists and philosophers meet.

A technical innovation commonly makes its way by force of validity and usefulness. It has been our habit to think of it as a simple net increment to previous knowledge. This is not as often so as we suppose. Innovations in ways of doing things do not fill a little vacuum; often they displace old ways of doing things. The culture, though flexible or elastic, also has strong inertial properties;

it could not last at all without some tendency to perpetuate itself. Thus although it accepts change, it also resists it. Even in physics as in all science, there is ample evidence of this, and elsewhere there is much more evidence.

The rate and kind of innovation and the interaction of technology and politics have taken on different styles in different periods.

The first important period is the one from about 12,000 years ago to about 5000 years ago (10,000 to 3000 B.C.). Beginning soon after the last recession of the ice, man accomplished a number of new ways of doing things such as:

Settled agriculture
Irrigation
Masonry construction
Textile manufacture
Metalworking
Brickmaking
Domestication of the horse
Wheeled transport
Ship transport

These things were accomplished by prehistoric man. They made it impossible that prehistoric times could continue. They brought the necessity and the possibility of taxes, writing, records, accounts, money, the state, and politics.

In turn the state brought organized capabilities and economic order and trade. Hence from about the time of the introduction of iron to the fall of Rome there was a new period. In this time there were few major and basic developments, but there was great and multifarious advance in the technology based on the earlier basic advances. The ship was greatly improved. So were harness, horseshoes, and the making and using of iron and other metals in all sorts of applications.

The classical age was confronted by a great and tragic wrenching. It had developed an economy, society, and politics such that a Republic was possible, with a people who could play a real and active role in politics, on the scale of a city-state, as in Athens, or in Rome up to about 100 B.C. The economy and politics then permitted and required a larger area. The role of the people in a Republic could not be maintained in the larger area, and hence the Empire replaced the Republic, eventually succumbing itself, though only after centuries, to the ills of the great state where guidance flows down from government to people without any feedback.

The age of the city-state had endowed Mediterranean man with a great fund of knowledge, doctrine, and sophistication about the organization and management of human affairs, including politics. Only a fraction of the great mass of population of the Empire shared this background. The intruder barbarians whose migrations brought the fall of Rome had little of it. They lacked also much of Roman technical knowledge and skill. Thus the new period, the early Middle Ages, was at a new and lower level than Rome in all administrative arts, and because of this, in the basic functions of law and order, and, in turn, even in practical technology. Bricks simply were not made in Western Europe for several centuries. And roads, bridges, and waterworks were nowhere constructed or maintained as at the height of Roman civilization.

The next period, as I would identify it, is from just before Copernicus to the beginning of the industrial revolution, i.e., roughly from 1450 to 1750.

Here once more we have really radical basic advances across the whole span including science, technology, art, exploration of the earth, and politics. Brickmaking, roadbuilding, and bridgebuilding became active, ironmaking expanded, and the ship became capable of keeping the open sea free worldwide. On the basis of these advances there was again a great advance in the nature of the state and politics, and again, as once before, a great flowering of applied technology. The modern state arose in the same period as modern physical science.

The start of the industrial revolution is still a matter of inquiry among the economic historians, but 1750 will do reasonably well as a time from which to measure it. Unlike the classical period, when applied advance displaced basic advance, the basic advance continued and accelerated. That period laid the the foundations for the one into which we have now entered. I would date the transition from around 1940.

The last period is the new one since 1940 called variously, the "technological revolution," the "second industrial revolution," or the "age of cybernetics."

It is noteworthy that innovation has accelerated a great deal in the course of history. Major discoveries of science and technology have been increasing in frequency at a more or less exponential rate such that those in 10 years nearly equal those of the previous century, and those of the previous century nearly equal those of the previous millenium, or in turn the previous 10,000 years.

Taken by itself this is a splendid trend. Two things must be said about it. First, it is a very significant measure of the potential capabilities of mankind, capabilities not yet fully released by good education and good social and political conditions. Second, however, it plainly cannot continue unbroken in the same manner. There is an obvious flaw in any such series. The series reaches an infinite value in a finite time. The rate of innovation really is not about to become infinite before some hour on a day in 1966, or any other year.

The rate of innovation has increased by about 10^4, whereas the population has increased by something between 10^2 and 10^3. The difference between them represents the gain in the probability that a potentially gifted individual will accomplish creative work. The increase will be much more moderate in the future, for the rate is already rather high.

The mainspring of technical innovation is, of course, science. The concept of science, as entertained by the scientists and the philosophers of science, has concentrated on "exact science." According to this a scientific truth is exact, general, and based on controlled experiment and has been confirmed and can be reconfirmed by repetition of experiment. Such exact science has had these characteristics:

Simple situations investigated, the laboratory
Single system and discipline
Precise measurement
Advances in measurement
Mathematical analysis
Theoretical explanation
Objectivity (the separation of observer and observed)
The community of science
Science valued for its own sake
Discovery as an article of faith
Test by use unnecessary
Test by exact repetition.

Actually there is now a vast area of scientific activity that does not fit that conception of science, and lacks a name. It deals with, produces, and uses a sort of knowledge that is not the same in all ways as the classical scientific type.

It resembles engineering in many ways, but creates new basic knowledge in its own realm. It deals with the practical, unique, and impure situation, as engineering does and classic science does not. But it also deals with the problem that involves several disciplines or orders, and is a creative science in the area of highly complex systems whose area contains the old boundaries between the several disciplines, and changes the idea of a boundary to that of an interface. Its experiments are in the practical world or in simulations, models, and games rather than in a rigorously controlled laboratory. It relies heavily on probability. It shares with engineering the final criterion of use rather than the independent test of validity as knowledge.

If we again examine the list of characteristics of exact science in its classic form just given, we find that this newer kind of scientific activity is not the same in all respects, but differs in some essential ways. It does not adhere to rigid laboratory controls but goes beyond them where they are impracticable. It uses a single system and discipline only when it happens to fit. It resorts to precise measurement when it can, and to rough measurement whenever necessary. Its advances in measurement are as much due to progress in calibrating the observer as to progress in the instruments of measurement. In using mathematical analysis and theoretical explanation it does not differ, and in its strong faith in discovery as a goal it is the same. But it simply does not separate the observer from the observed through experimental control, with the scientist outside the test tube; its characteristic investigation is of a purposive activity involving men and values. It maintains the community of science, but throws new linkages across the boundary with society. It does not concern itself with science for the sake of science; it finds test by use essential, and test by exact repetition of exact experiment has only a minor place.

Thus the new science has broken with the old exact science in several respects. It no longer stops short when exact data are no longer available. Its goal is, as some say, the most rational use of the mind. This does not stop at the bounds of perfect data, for the most rational thinking does not depend on the quality of data; the quality of the data is just one of the circumstances of the problem situation.

This stuff is not the familiar "soft science." It is not condemned to that limbo of the humanities and other descriptive, thoughtful, linguistic subjects like history and all nonbehavioral political science and sociology. It uses symbolic mathematics constantly, even where it can measure nothing. It even uses cardinal numbers where it measures nothing.[1] It is the area where symbolic mathematics and computers are in use with or without firm laboratory determination of all the data. It is the field of large and costly analytic activities that apply hard method to soft data. It is the area where we have some of our most pretentious knowledge of structure and the skimpiest basis on which to answer critical questions on validity. It is the area where we most often take the opinions of experts, and then analyze and synthesize them in elaborate ways. It is the area where probability and temporal circumstance tend to exclude the exact repetition of experimental results.

There are occasions when the data are all hard data, and the analytic operations are also firm. The equations contain all the necessary factors, and the quantities have all been measured. Then we are back in classic science. But when the models run for many pages they have gone beyond the hard data process. They simply cannot be checked empirically with precision.

In this area we do not validate our results by going back to the laboratory. We validate them as well as we can by critical discussion. Since their purpose is to help in guiding some real action, there is an empirical test, but not the same sort as in hard science. This empirical test is complex, uncontrolled, open to the intrusion of new factors, and impossible to record with precision. The feedback from such a test is not like that from a laboratory test; rather it is through the more or less objective impressions of those who participate in the experience. There remains a sort of validation. We are convinced that we learn a great deal that is worth learning.

The important fact is that this new science that differs from the classic type is now a major source of technical innovation itself, and at the same time it serves as a new main channel between the exact sciences and politics.

POLITICS

Given some such description of the sources of technical innovation, what of politics?

Politics is the activity that decides, for a large number of people engaged in social action, what will be done and who will have what role in directing it. It is the cybernetic function in any group or association. It is focused more than anywhere else in the life of the state.

The state is that organization or association that has the unique function of providing the conditions on which the cybernetic, or the steering, role can be played by individuals for themselves, or by any and all other groups. To do this it provides the rules and referees for all competitive game-type situations, and the counters, i.e., money. Also in multifarious ways it provides the services that are most essential to freedom, and all subordinate life, from clean drinking water to roads and bridges. It protects a society in its territorial extent against invasion or domestic violence. It directs what must be directed in common and provides the conditions that permit freedom of direction of what it does not direct.

To do these things it engages the full-time activity of some fraction of the people in a society. It raises taxes. It organizes military forces. It conducts war. It undertakes great works. It provides law and justice.

The acceptance of the role of director, for any person or persons by many other persons, establishes political power. The exercise of power is a thing that is strongly motivating to mankind. It is universally true that the man who exercises power holds a position that many would like to hold. It is universally true that his share of the dividend is superior to the common share. Politics is then the activity of establishing and maintaining the general decision-making and the decision-facilitating apparatus and operating it. It has two grand sources of motivating energy, the need for the steering function, intrinsic, and the desire to enjoy the steering position, i.e., power and influence, extrinsic.

Society has been made up of people having quite different educations, or mental loadings. Different backgrounds of factual knowledge, value systems, logical patterns of interpretation, and narrow points of view have left the public, not only in the world but in a nation, a city, an association, or even a firm, with disparate mentalities on problems of common concern. Hence it goes almost without saying that there is tension, faction, strife, and in the absence of law and order, war.

The anarchists held cheerfully that all this is not necessary, but anarchism is fading out of fashion. It is somewhat too obvious that freedom itself has as a prerequisite the conditions of order, the premises, given by the state.

To illustrate, if only roughly, imagine the situation of a merchant without a state. His next act, if not already taken, must be to acquire arms. His next must be to organize a poor little state for himself, and a group of men in his service. His next must be to complain that business is bad, and his next after that is to join with men of like mind, who will not be lacking, to establish a proper state, and demand that it provide police and law and money. To escape the question of bias by the term "merchant," let the supposed individual be peasant, laborer, or anyone else, and a parallel course leads to the same outcome.

We can also describe the nature of social life without a state in the new terms of game theory or of the analysis of complex systems. In these terms, life without a state would be life in a system of games played without rules. It would be extremely inefficient and rather violent, and terribly subject to luck. If we spelled it out we would arrive at a paraphrase of what Hobbes has already said of us 300 years ago; life without a state would be solitary, poor, nasty, brutish, and short. Or simpler, it would be fruitless, frustrating, and, really, boring.

So we have states, and, as we know, states have diseases. The loss of feedback from people is the prime disease of states. The vicarious impulses of politics all too readily depart from the essential function. So then, in the history of politics, we have an evolving and slowly progressive art by which to ensure that the state will sense the people. This requires that the people know how to control the state in some broad manner, with some degree of judgment. The real capacity of the people to do this has been very low at some times and places, and extraordinary difficulties can ruin it.

The conduct of politics has to use two sorts of knowledge or inputs:

(a) The knowledge borne by all the real elements of the people who know, by real experience, a great deal about their own interests and situations that cannot be so well known by anyone else and who have really unique knowledge of their own feelings, motives, and values. This is special, i.e., any part of it is relevant to some political actions but not all. It is the democratic element.

(b) A professional knowledge of the logic of politics, what sorts of actions lead through strain to later success, what sort through an early profit to a more distant bankruptcy. This is general, i.e., it is relevant to all political activity rather than just some. It is the leadership element.

The problem of modern politics is to utilize, as it must, the real elements of the people in the first capacity, without which the equations of power cannot be written, let alone balanced and solved. At the same time, means must be found to bring the second kind of knowledge to bear, through those old, tried,

and laborious processes of constitutional government and education, and the development of an elite of political leadership, in the complex form required to reach from the centers of knowledge in the dens of the scholars to those in the rostrum, the forum, and the great hives of administration.

If simplification may be allowed, since we cannot touch so broad a subject without simplification, we might say that the modern democratic systems, e.g., the US, the United Kingdom, and France or others, exhibited a quite effective mastery of constitutional politics according to the first class of inputs in the early twentieth century but in that same period exhibited at times a serious lack of the second class of inputs. And, to indulge as one also must in a bit of optimism, one may say that those same democratic systems have displayed a notable increment in both types of inputs since the middle of the century.

EFFECTS OF TECHNICAL INNOVATION ON POLITICS

The evolution of a full-time standing organization for the performance of central functions of society was necessitated by settled-land use, and the consequent needs of defense and order and therefore of taxation and administration.

The growth of the state from its rudimentary forms in tribalism to the earliest forms of which we have historical knowledge was, like the advance of technology in the same age, prescientific in its intellectual character. But its results were none the less great.

The earliest states of which we have historical knowledge already rested on an accumulation of political sense. The art of statecraft had been born. Primitive man had known how to assign the function of judgment to a chief and to establish a war chief. He had not known how to tax, keep records, and organize sufficient power to hold authority against casual challenge. He had known how to let a council of elders settle difficult affairs. He had not known how to design a constitution. He did not know how to organize public works.

The political evolution from the beginning of history to the Periclean Age in Athens was extraordinary. It created the secure basis for civil life in such effective ways that it could bring a people to the capability needed to operate a republic.

Yet the first historical states lacked the elasticity needed to accept the effects of further technical advance. Even the economic and technical successes that they enjoyed strained their fabrics beyond their limits. Their technics stalled after the time of Archimedes.[3] Their political flowering stalled out in the Roman civil wars.

In the whole past development, innovation in politics has come little from rigorous science or technology, and much from the nonrigorous empirical art of prescientific character. To this we must attribute the complete growth of the art of organizing states and conducting politics. We cannot exhaustively list or analyze the range of development, but it has included:

Public works
Law
Military forces
Kingship
Courts

Police
Treasury
The legislative body
The consiitution
Treaties
Ambassadors
Civil service
Election
Parliamentary system
Presidential system
Federalism

All these were developed before they were described. All arose from the same great well of the advancing arts from which all techniques came before the rise of systematic science. All were made possible and necessary by the advance of the technical arts affecting economic and social life and the culture in which we are made civilized or educated. No comparable innovation in politics has ever yet had systematic science as its immediate source or origin.

The effects of technical innovation on politics then have been through a sequence leading from a much more systematic order to knowledge and practice: science; into one that has been far less systematic or analytic: politics. The indirect, erratic, and unplanned nature of this process has been natural. The interaction of a science with a nonscientific art has not been conducted by the rules of science.

The effect of technological advances on politics is not just one kind of effect. The effect is not through a single channel or path but through several different ones. These different sequences have to some extent been of different relative importance at different times, but it is also possible for any of them to be quite active simultaneously.

TABLE 1

Paths of Causality

Cause	Central functions of society	Means of executing central function	Effect
Technology	Service and order requirements	State	Politics
Technology	Military superiority	Imperialism	Politics
Technology	Wide-area administration	Expansion	Politics
Technology	Education	Independence	Politics
Technology	Industry	Social classes	Politics
Technology	Business cycle	Economic management	Politics
Technology	Communications	Public participation	Politics
Technology	Public capability	—	Politics

The eight paths shown in Table 1 are each just a very brief indication of a path of causality from technological causes to political effects. They illustrate the matter, not exhaust it. They do serve to suggest how fallible any one model might be.

There is one very simple way in which to measure the effect of science on politics in the last century: the effect on Marxism. The diagnosis and prognosis of Marxism was, in all essentials, to this effect:

> Advancing technology changes the mode of production, and the organization of production. It creates the working class and the capitalist class. Between these there is an inevitable class struggle. This eventuates in class war. The ruling capitalist classes cannot possibly solve the problems presented. The working class or proletariat has to destroy the capitalist class and establish a new classless society free of the contradictions of capitalism.

Thus Marx developed by extraordinary effort a grand version of the industry/social class model. History has failed to fulfill the Marxist predictions very largely because the course of events has been in accord with the last three: the business cycle, communications, and public capability. Political history has moved far more under the impulse of science than under the impulse of Marx.

THE NEW SITUATION

In the world as we have it, several of the paths of effect have outstanding importance, especially through wide-area administration, education, communications, and public capability.

Of wide-area administration we may say—Technology has changed the capability of man to communicate over distance, or to transport people or freight loads over distance, in constantly increasing degrees over the past century. It is feasible now for a political leader to appear on television before a hundred million people spread over thousands of miles. It is possible to move coal economically from Chesapeake Bay to Japan. It is possible to deliver destructive missile weapons from any point on the earth to any other. It is possible to provide schools and books to spread ideas to all mankind. The structure of information generating, transmitting, and receiving and the structure of economic action in space have been changed by a very large factor. This is in a world where the major geometry of politics is still that which was settled in the horse and buggy age. Hence we are in a revolutionary reconstruction of economic, political, and military space, symbolized by a Common Market, and by alliances and federal movements, and by a worldwide military-deterrence-cum-cold-war. John von Neumann wrote a perceptive article on this a few years ago.[1]

Of education we may say—Technology has also brought enough modernism into vast areas of Africa and Asia that once were called "colonies," so that the peoples there have enough political sense and feeling to insist on independence. The phenomenon is not as simple as the term, but it has been made good in many cases by the native people showing a capability to make the former colonial power concede the case.

And of communications and public capability—the real future of politics lies in the path through education and communication to the increasing capacity of the people. The change of political space structure for physical and logistic reasons will occur anyhow, but how it will occur, by bitterness and violence or

by reasoning together, depends on our capacity to reason and to recognize reason. This capacity can change.

The first two of these processes—wide-area administration and education—have been with us for some time but are suddenly having more radical effects than before. These effects are one-time effects. All the world cannot be brought into close swift contact by technology over and over again. All the onetime colonies cannot be made independent more than once. The two processes plainly work at cross purposes in elementary terms, for one tends to unite and the other tends toward fragmentation. The strains inherent in the situation are not less but greater than those that have caused the most gigantic wars and revolutions. Yet the historical process is not running in the old rut. There is some appearance that the capability to adapt is keeping "its head out of water." If so, this is new. If it is so, then it is because of factors related to what I have called public capability, i.e., a degree of rejection of simple will and force because of a degree of broadened and deepened confidence in analysis, understanding, and discovery. If so, then this arises largely from the effect on politics of the new class of applied science that was spoken of earlier. This, and its effect, require further discussion.

The effect of the new sort of science is felt in combination with some other factors in a way that is quite different from the effect of exact science. Its scope is not confined within a few disciplinary subject areas but extends to the scope of a problem, without regard for disciplinary boundaries. It does not confine itself to the introduction of absolute rigor within the confines of a few subject areas. Rather it extends to the introduction of some increment of discipline in the context of any problem of social action whatever. It extends with easy readiness into all the behavioral sciences, and into all highly organized procedures, from the organization of universities to the elegant order of international air travel. It has a strong and spreading influence in the conduct of military affairs, symbolized by the role of Mr. McNamara, and feeds out across an open frontier into all civilian life. It is the activity of a professional body that differs from the old community of scientists in their intimate relation to the whole society. The continued advance of communications and education combine with this in a positive way, and what I called education, communication, and public capability begin to work together wholly. In a sense, political innovation is becoming a part of technical innovation, rather than the indirect end-product of an obscure causation.

To the extent that this is so, and if we come to recognize this area as a real one and as having inirinsic worth, then many things follow.

The emergence of the "action sciences" or "policy sciences," and their marriage with statistical mathematics started in academic circles in the twenties and thirties. It was given a great boost during WWII. This was natural. The war was a far more favorable climate for the application on analytic methods to operations and policy than was the prewar period. Military affairs, in war, is one area in which our cultures have acquired a readiness to resort to all promising new means, even at great costs. Also the military area is one in which, with or without rigorous science, there has long been a wide recognition of the fact of responsible realistic judgment by superior commanders and the lack of it by inferior ones. A regard for real numbers, real distances, and real difficulties in logistic orderliness has been customary. Not all the military

were eager for the aid of systematists. They still are not. But they were sometimes more receptive than other elements of the powers that be, such as those who control the economy, business, or government. At any rate the war brought an enormous opportunity to the practitioners of the new kind of science and was quite sufficient to secure their charter, funds, load of work, and tools. The new field was born in close relation to the state and politics, and it has fully retained this connection. And even if C. P. Snow discovered that scientists and humanists are worlds apart, the war started the soldiers, scientists, and politicians, and C. P. Snow toward recognition that objective analysis is their only common language.

More and more, on all kinds of problems, one finds people emerging who affirm that the immediate obscurity of any problem awaits the intrusive mind. There can be an explanation. There is some definite method by which to learn to solve a problem. The more objective analytic approach should be tried, because it is preferable to the old partisan-adversary method. In this area there are many streams converging such as:

Semantics
Communications theory
Behavioral science
Systems analysis
Theory of games
Cybernetics
Decision theory
Symbolic logic
Operations research
Management science
The "policy sciences"

The new semiscience is somewhat of a return from the dominance of experimentalism toward the dominance of logic. However, of course, it is, like experimental science, concerned first of all with natural realities. It reasons from data that are like the data of rigorous science in their form, though only partly so in the rigor of their derivation. The object of its attention is usually some sort of natural phenomenon, sometimes including artificial and social phenomena, but not, so far as intention goes, pure abstraction. It is consistently inductive in form, or tries to be so, and even when it resorts to the opinions of experts for lack of other data, it then employs these in an otherwise inductive manner. Hence, although it accepts the necessity on certain occasions to use such inputs of deductive origin, it at the same time makes its way into realm after realm of problem areas formerly dominated by the authority of office and by deductive reasoning, substituting as it goes the dominance of the inductive style, and, so far as the facts permit, of inductive substance.

This changes the nature of the tests by which it can be proved or validated. In the classical sciences the standards of good work were the criteria of truth and the canons of criticism. Criticism is very important. It is the live and active evaluative function in science, as in art. An important observation to make about the new semiscience is that it lacks clear standards or canons of criticism.

If this is so, then some more things are so. First, lacking strong criticism, semiscience is exceptionally liable to unchallenged bad work. The model builders

are commonly expert in that trade, and often tyros in the real substance of the matter that they treat. When they are uncritical or naive about realities they can perpetrate extraordinary feats of foolishness.

The situation calls for some means to increase the effectiveness of criticism. Of course this is easier said than done. Practitioners and clients alike must learn to present and accept results as the best light that can be thrown by systematic work but not to present or accept them as rigorous when they are not rigorous.

There is another thing that might be done much more often than hitherto. That is, in cases where a semiscientific study has given advice that has led to decision, there should be a systematic postmortem. There is always a kind of postmortem in such a case but not often the kind we need; it is on the action level and does not, except rarely, feed back to the research level. This leaves us with little measure of how good or bad our findings and advice really are. If there is no scorekeeper, how can one know?

CONCLUSION

The insights of cybernetics lead easily into dreams of grandiose planning by computer. However, equally well they lead to recognition of the unique inputs of the individual man and the necessity to grant him freedom to act for himself as a system, within the larger pattern of organizations and society as a larger system. The function of the state is not and will not be to swallow the whole of the human cybernetic function. The function of cybernetics is to serve the capability of people, not to generate a new tyranny.

So, what is being accomplished is a change in the capability of the people in politics. The change was not very well predicted by any scientific or learned authorities. It is contrary to Marxism. It is coming on us in a period strewn with other and great failures but not with the kind that was predicted.

The increase in influence of the rational or objective spirit was not too apparent before 1945, but mark the tally of achievements since then. We need admit to the record only those that are of a new sort, unknown to modern western history before 1945. Then they may include the:

Acheson-Lilienthal proposals
Marshall Plan
NATO Alliance
Liquidation of colonial empires
Common Market
United Nations, and more

These are the first little tokens of the age that we have entered.

So far then my view is optimistic, but no one will really think that I mean to leave the picture simply rosy. We are near the brink of a new phase of history, but the difficulties remain gigantic. The world has been very quickly changed in our generation, and world politics now engages all the world instead of a quarter of it. The agonizing strains of development contain enough of the causes of war and revolution and the savageries of civilized and uncivilized man to make our worst past calamities look small. The point is not that the happy ending is now sure, as in a bedtime story. The point is that we live on this

planet with that property of life identified as dramatic, that is to say, life can turn to tragedy or comedy. The good news, if it be taken as such, is that we have new means that give us new chances.

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Political Development: Neglect or Aid?

ABSTRACT

The concept of political development has come to the fore gradually over the past decade but has not yet been given a status in the structure of policy comparable to that of economic development.

A large number of nations exhibit a lack of political development that threatens their political stability and impairs the effectiveness of economic and military aid if such is given.

US policy, with the Marshall Plan, military aid, and alliances as major features, lacks a specific approach to the problem of political development. Although counter-insurgency has been emphasized in recent years, this is a negative policy lacking a positive counterpart.

There are strong historical reasons for the exclusion of aid in political development by one nation to another, except in the case of colonial status. Meanwhile, colonial status has been substantially abolished and is not regarded as legitimate. This poses a problem: can measures to assist political development be put into an acceptable form?

The choice might be to exclude such measures and neglect the problem. However, the politically undeveloped nations also carry a threat to the stability of the advanced nations, and of the world, and such neglect is not to be accepted if any mode can be found that would serve the purpose.

In contrast to the past, when existing doctrines of international relations were established, there is now a much greater fund of professional knowledge available, on which assistance in political development might be based, without colonial status as a main linkage of donor to receiver. This knowledge is more analytic than the political knowledge of former times and more communicable.

The time appears to be ripe for a serious effort to bring the problem and pertinent knowledge to a focus, ripeness being indicated by the large scale of research, scholarly studies, and other indications of interest and concern.

CONTENTS

INTRODUCTION

One of the major unsolved problems confronting the US today in its policies toward the rest of the world is the problem of the political development of newly emergent national states.

This is a problem to the US because such states, through internal instability, represent dangers to world economic, political, and strategic stability or the balance of power.

This problem of political instability and political development is the major unfinished business left from the development of US policy—diplomatic, economic, and military—to stabilize the world situation.

The central question is: Can any feasible and effective means be found by which the US can assist nations that are in serious need of political development? The objective must be to attain a rate of political development substantially better than that attained by the unassisted course of events.

To understand whether the US can lend an effective helping hand in any new ways, one has to examine the process of political development. That is basically a problem for each nation by itself. It is the problem that affects a great number of new nations and some old ones to a degree that threatens to generate insurgencies, factional strife, and disorder within nations and between nations. It threatens the US programs of economic and military aid with failure in some cases owing to internal political failure in the nation receiving such assistance. It makes the nations affected by such political weakness a fishing ground for Communist influences, stakes in the power competition of the great powers, and a source of instability to the world.

There are historical reasons why political development, except by a colonial power in its own colonies, has been almost wholly left to the internal factors in a country to work out. There are, however, some new conditions that seem to offer a prospect for assistance by such a power as the US to the states struggling in the early phases of such development.

The subject is discussed further in the paper under the following heads:

Problem
Omission of the problem in the US policy structure
Historical background for its neglect
Why is neglect undesirable?
Are there new possibilities?
Can legitimacy be established?
Is the time ripe?

PROBLEM

First, there is the intrinsic situation to be described. What are the characteristics of the politically undeveloped nation? What sort of process is involved in the transition from undeveloped to the politically mature condition?

A large number of nations suffer from more or less serious political weakness. These nations include many of the newly independent former colonies, and a number of others that have been independent for a longer time. Political weakness is indicated by incapacity to find policy solutions for their acute economic and social problems, and by their instability, frequency of coups d'état, and revolutions. Confronted with population explosions and rising expectations they are unable to attain adequate rates of advance for productivity and unable to solve either economic growth problems or problems of internal order and military security because they are unable to solve problems of a political nature.

The Type Case

Without attempting a precise description of any particular country the common characteristics of the class with which we are concerned can be sketched as follows:

The economic system is limping. It is short of "takeoff" in the sense of the term as used by Rostow. The rate of capital formation is too low to provide a gain of gross national product over the rate of population growth. The indigenous elite are based on land ownership and commercial activity, with only a small element of modern productive enterprise. The system of ownership-authority controlling land use is not motivated to technical modernization. The weakness of the political system feeds back as a lack of confidence in long-term risks, a high interest rate, and an emphasis on quick profits, amounting to a zealous concentration on the "fast buck." This carries over in the form of political and administrative corruption, prominently displayed in the continuing record of retirement of ex-presidents and other émigrés with large fortunes. Apparently important economic measures can be taken in such a situation with little real effect, and especially with very disappointing secondary effects. Major public works and electric power developments have been disappointing in some cases, and even land reform has had very disappointing results in some places where the simple dispersion of ownership has not been accompanied by equipment, fertilizer, and knowledge of modern agricultural methods, including new crops, marketing, and storage facilities. The disappointing experiences date back farther than is sometimes noticed, since the names or slogans or programs get changed when they become worn out. The "Good Neighbor Policy" and "Point Four" have both disappeared from current usage long since because they did not "cut the mustard."

Politically these countries lack solid patriotic nationalism. This is perplexing, but this is only because we forget that patriotic nationalism is a thing that has been developed since a time when it did not exist, in any country that now has it. They also lack any vigorous grass-roots practice of democratic politics. This ranges from local legislatures across the board including school

committees, PTAs, labor union councils, business associations, and all the other minor forms in which negotiative pulling and hauling, within constitutional restraints, is conducted in the mature democratic countries. (Hannah Arendt emphasizes this in her book On Revolution.[1]) In national politics they lack constitutional restraint, as exhibited best by the use of the coup d'état in lieu of the election, or in addition to the election, as a means of deciding power. They lack mature national parties and especially lack the concept of a "loyal opposition" (it may be noted that the concept of the loyal opposition was a specific and conscious one in England before the beginning of the Industrial Revolution). The social, economic, and political elite groups are isolated from the mass of the common people, with a considerable degree of antagonism, dissent, and latent rebellion. The people themselves remain largely embedded in family, tribal, and parochial loyalties, short of emergence into modern or civic culture and personality conditions. Historically, even in Europe the elite based on landholdings seems incapable of leadership in economic and political advance. There is very great difficulty in formulating a program that both the elite and the common people can see as advantageous to all concerned, as against maintaining the conventional order to the advantage of the traditional elite, or embarking on radical measures to the purported advantage of the common people. The strong infusion of commercial corruption into the political system is a significant factor in this. A consequence is that the difficulty of reform, as always when such difficulty is very high, promotes consideration of resort to the much easier and more effective political solutions of dictatorship, whether to freeze the status quo or to change it. Whatever caveats and qualifications attach to it, dictatorship does arrive at a superficial solution of the power problem more easily than does the democratic process in such a situation.

Relative shortages of educated and trained personnel are an obvious concomitant of the "underdeveloped" condition. These countries have high levels of illiteracy and low levels of school enrollment.[2] The cadres of high school and college graduates in every area range from low to abysmally low numbers relative to population. This affects not only the supply of good engineers, medical doctors, and scientists, but it applies at the levels of agricultural school graduates, and technical high school graduates also. Correspondingly the relative number in the population who represent the uneducated and unschooled type are so much the greater.

The mental type of the wholly uneducated tribal peoples is not to be mistaken for simple childishness. The mind of an intelligent infant is ready to develop into the mind of a primitive man or of a modern Western man. The mind of a primitive adult is not ready to develop into a modern mind. The difficulty of shifting to modernism is severe for such a mentality, and the historical fact of long delay and apparent resistance is apparent in even such a case as the American Indians. A foundation book on this general problem is Lévy-Bruhl's book, now about 40 years old and far too little known.[3]

These facts are introduced here only as background concerning the political ignorance and inexperience that affect such peoples. Their best political leaders may be as good as any. However, putting the thing in terms of the structure of an army, this is like saying they have a few fine generals, and a terrible dearth of competent officers, and a still worse shortage of sergeants.

The Political Development Process

The political capability level of such a society is more like that of England under the Tudors than like that of the United Kingdom or the US today. It may be recalled that 300 years ago England had not quite passed out of that phase in which a change of administration required a coup d'état (as in 1688) and in which civil war could still occur (as in 1745). The formation of responsible parties lay then far in the future. The concept of "His (or Her) Majesty's loyal opposition" arose only in the early eighteenth century. A great long series of major political developments and reforms including the evolution of the cabinet and extending to the introduction of women's suffrage required a full two centuries of British history. Those two centuries went to furnish the thought and practice of administration and politics that is represented in the active life of the English body politic today. Our friends in the Congo, Laos, among the Montagnards of Vietnam, in Bolivia, and elsewhere lack all this political development.

The extent, character, and rate of progress of the process of creating an advanced political community is something on which we really now have a great deal of historical evidence. Just in brief:

(a) To develop the capabilities for the conduct of politics that we are familiar with in England today, out of those that were present in England at the time of Henry VIII, required 400 years.

(b) To develop the capability of Germany today, just from the time before the Great Elector, took 250 years.

(c) To develop the capabilities of France since just before the French Revolution took 175 years.

(d) To develop the capabilities of the US, just to the time of the founding of the Republic, took a century on this continent, starting from mid-seventeenth century England in political capabilities.

(e) To change medieval Japan from its political conditions before 1869 to its present condition has taken a century.

(f) To change Malaya just from the condition when Lord Templer went there to the condition when he left took 5 years.

The implication is not necessarily that we can do nothing but wait for centuries. The impacts of modern technology and modern politics are a new factor, one that was not present in the sixteenth, seventeenth, and eighteenth century environment in which the political foundations of the West were laid. Modern technology is already imposing the population explosion and the "revolution of rising expectations." The political development of these peoples will be much swifter. Therefore it will also be more strained, violent, and subject to faction, dictatorship, and police-state methods, unless extraordinary efforts are made from elements within the nations concerned, and with very wise and sensitive help from the West.

Thus far the help from outside has been generous, but often marked, as has been said, by "naiveté and ineptitude."

Thus of the process, we can add:

(a) That it does not happen easily and quickly.

(b) Strong economic development occurs after some degree of political development and not before.

(c) The level at which a people are ready to demand independence comes before the level at which they may attain stable self-government (the US was the exception).

(d) Political development does not stop at any level yet attained by any nation.

Channel of Transference

The idea that one country can do anything to help another to cope with its own problems demands that there be something useful in a form that can be transmitted from the one to the other. It is quite feasible to transmit money from one country to another, or arms, wheat, military training or advice, or textbooks, but the transmission of political savvy has only rarely been accomplished.

The best examples are few, for they require some conditions that are not very common. First is that the giver have something to give. Second is that the receiver be well able and strongly motivated to receive. Third is that there be an adequate channel for the transmission.

Great Britain did this in a way for the American colonies that became the US, and for other once-colonial areas that became dominions or independent, such as Canada, New Zealand, and Australia. So far as these examples go, the transmission was through capable people, carrying with them the English experience, customs, English history, English books, and the English language.

But England did it also to a very substantial degree in India, some parts of Africa, and in Malaya, and the US also accomplished it in the Philippines. There it was not solely by migration of people serving as carriers of the political knowledge and ideas, though always partly by that; it was more through the example and teaching of the few colonial administrators, transmitting the principles of honest administration, justice under law in the courts, and common loyalty among divergent parties in local and national elections and legislative work.

England conducted these examples in the status of colonial power, with authority as an instrument; the US also.

Japan is another case. There the impulse was on the part of the recipient rather than the donor. Japanese political history shows that it was not all easy, but Japanese political history also stands as an extraordinary case of very great progress, even with a great defeat thrown in.

OMISSION OF THE PROBLEM IN THE US POLICY STRUCTURE

The structure of US world policy has its roots back in the immediate aftermath of WWII. Initially the stabilization of the world was already a goal, with the United Nations Relief and Rehabilitation Administration, and the World Bank Fund as major instruments. That was a system based on the assumption that friendly cooperation would characterize the relations between the US and the USSR. This assumption was gradually swept away in the next 5 years. By 1947 Greek and Turkish Aid was based on a recognized necessity to oppose Communist aims. The Marshall Plan in its incipient phase in 1947 was still open to Soviet cooperation, but this brought only the open opposition of the Communist Bloc. The Korean War removed the last vestiges of hope for the cooperation of the two "superpowers" in any early time frame.

In the transition period the great main pillars of policy were set up: the Marshall Plan, the NATO alliance, and military aid. During the following decade the greatest emphasis was given to the development of a military posture strong enough to provide for stable deterrence of major war. The most recent major adaptations were the shift of emphasis from all-out war toward "flexible response" and the measures taken 3 or 4 years ago relative to counterinsurgency.

The presupposition of the Marshall Plan was that economic aid was essential to enable many European nations to surmount their acute economic problems just after the war, but that their political systems could reach stability if so assisted. The presupposition of military aid was, in parallel, that many countries lacked sufficient means to meet the internal and external military threats, but that given some aid their governments would be capable of maintaining stability.

The case was not envisioned for which economic or military aid or both would prove ineffective because of the lack of political competence of the whole sociopolitical system. The government of any recognized nation was taken in good faith as sufficient in all political respects to use the aid that was given.

Several developments have occurred since the period in which the great structure of US policy was created. The political roots of the economic and social ills of Latin America have attracted increased attention and study, although the lack of critical immediate danger has left the subject in low priority status for policy except for brief spasms of attention. The worsening of the Vietnam situation has slowly brought the political question from the taken-for-granted status into the forefront. The Congo and some other African states, though not directly in the US lap, have emphasized the existence of the problem and some of its dimensions of difficulty.

The recognition of political instability as a problem has, however, been rather slow and somewhat evasive. The US was more or less neutral, officially, in cases of rebellion against colonial powers, where the rebellions were not plainly Communist-directed, from the time of the first such rebellions down to the time when Algeria gained its independence. The American press and public sympathy were inclined toward the side of the rebels in many cases. This covered both outright rebellions and some other related anti-imperialist events such as the seizure of the Suez Canal by Egypt. It was exemplified by the sympathy of the New York Times[4] for the rebellion of Castro against the Batista regime in Cuba, up to the time when Castro was clearly established to be a Communist.

There were cases, however, where there was either clear Communist direction, or extreme savagery on the part of rebels, or a fair case that the rebellion was against a regime that was doing its best to attain reforms and progress. Such include the Philippines, Kenya, Malaya, and South Vietnam.

The impact of the Cuban case, with the sharpening of the problem in Vietnam, fell in the years 1961 and 1962. The US reaction was expressed in the concept of counterinsurgency. This concept solved some of the problems of American thinking. It facilitated the official switch from favoring rebellion, at least in case of doubt, to opposing it, except in clearly justified cases (now very few). It also provided a term under which to organize and coordinate efforts within the sprawling US departments, and under which to commence some research efforts. However, it also tended to neglect and obscure the

problems of preinsurgent stagnation and frustration on the one hand and of how to attain effective economic growth and political development on the other. It marked a turning point in US thinking, both official and public; it did not conclude the policy issues but rather opened them; it remained to get on with the work that had only been started.

There are of course some features of US policy that are directed to the social or political aspects of development in addition to the economic or military. The Peace Corps ranks high among these, and technical aid and the United States Information Agency are also related to the problem. These, however, avoid the main issue or touch it tangentially rather than face and accept it directly.

The entire body of policy is highly developed for practically any sort of case in which economic or military assistance to another nation will enable the government of that nation to surmount its immediate problems. It only lacks any clear policy or means to be applied in the case where internal political weakness may make economic and military aid ineffectual. The question is: Can there be any extension of policy and means to cover such cases, or would such cases better be written off?

HISTORICAL BACKGROUND FOR ITS NEGLECT

There are strong traditional reasons for excluding political assistance from US foreign policy. Throughout the history of the nation-state system, interstate relations have been conducted under international law and by diplomacy. The only mode for political assistance by one state to another nation or people that has been regarded as legitimate is the colonial relation. In this relation, political training or tutelage was regarded as legitimate and even as an obligation or mandate.

In one respect the problem is the technical one of the initial separation between legal legitimacy and what might be called "ethical" legitimacy, followed by the conforming of the legal to the ethical view.

The authority of a colonial power, say of the English in India or of the French in Indo-China, was recognized as legitimate in legal status, under the system of international law and associated ideas, in the late nineteenth century, and for most of the first half of the twentieth century. Within the content and logic of that system it was proper for a colonial power to rule the colony, but also it was more or less presumed that such rule should be oriented toward the social, political, economic, and cultural advance of the people of the colony toward conditions such that they might reach self-rule. This latter idea was put forth clearly in the book by Lugard, The Dual Mandate in British Tropical Africa.[1]

However, the ethical legitimacy of the rule of colonial territories and peoples by the government of another community was under question in western thought long before this century. The Wilsonian concept of self-determination, expressed in the League of Nations charter of 1919, reflected this and gave it added strength, and the shifts of ideas that occurred during the high intensity of WWII brought a general acceptance of the idea that colonial subservience of some states to others must go. The idea of political maturity or immaturity

as a criterion was more or less swept aside. It became politically a bad bargain to try to maintain colonial authority; a bad bargain in the colony, a bad bargain in the ruling country, and a bad bargain before world opinion.

There is one important matter of fact that stands apart from matters of ideology. A people formerly ruled by another could reach a condition in which the native elite, or some elements of it, with mass sympathy or support, could demand independence, and could back up the demand with measures of protest, passive resistance, and active insurgency, such as to make the maintenance of the old order excessively costly and difficult. Partial reforms are then rejected, and the situation for the colonial system of government gets worse and worse. So the practical facts, impinging on the minds of people in the ruling nation already indoctrinated with the doubt of ethical legitimacy, provided a stronger basis for a trend in public attitudes, and thence in government policy, toward granting independence to former colonies where the pressure for independence was manifest and stubborn.

The results of these two factors, the ideological-ethical and the practical protests and insurgencies, was the partly deliberate, partly precipitate emancipation of former colonies. Where it has been deliberate, as in Malaya and Kenya, it was accompanied by accelerated measures to prepare the capability for self-government. Where it was precipitate, as in the Congo, it brought a revelation of acute problems beyond the capability of the new government to master, at least in the short term.

Resistance to the trend has been exhibited only in a few instances. The so-far successful effort of the Portuguese to continue their system of rule in Angola and Mozambique is the principal example.

Thus, in the course of the last two or three decades, major developments affecting what is practicable in the relations of the advanced countries to the underdeveloped have occurred, leaving a fundamental weakness that affects the world.

Colonialism was the only mode or channel for political tutelage of an undeveloped nation by a mature one that ever enjoyed legitimate status. Otherwise, under the nation-state system, as developed in Europe and the world since the seventeenth century, any interference by one nation in the politics of another has been regarded as pretty much immoral, illegal, and subversive. American objection to the operations of Citizen Genêt in 1793 stands as a classic case. Thus the force of traditional doctrines is mainly stacked against any direct role in the internal politics or internal development of one country by any agencies of another. The only channel accepted as legitimate is the diplomatic one, and this is supposedly barred from dealing with the people behind the back of their own government. The fact that the Communists have consistently violated this principle does not help, since we have consistently condemned their practice.

The case of the American Revolution is a source of difficulty, for it is the outstanding historical instance of the attainment of political maturity, and at the same time unique and atypical. It is the one case where the capability for strong insurgency was not reached long before a capability for self-government. It is the one case in which the colonial elite, at the time, needed lessons in the principles and practice of politics from no superior authorities on earth. It is the case where the fund of political knowledge, derived directly from the

Mother Country by migration, plus practice in local government, was obscured by a tendency to forget that English political development was a part of the American heritage. Historically, it seems that the same capability that was shown by the US was expected of other former colonies, where the facts were entirely different.

The difference of condition that makes it far more difficult for many other countries or nations to step into a political capability, like stepping into a new coat, was a standing mystery to most of the world. The former colonies of Spain and Portugal in Latin America became independent in the period just after the French Revolution. They adopted republican constitutions. Then they stalled out. Their histories recount a series of idealistic reforms, revolutions, coups d'état, and dictatorships. Their economic progress has been consistently far slower than that of the US, and their political progress very disappointing.

Meanwhile, analytic sociology, which did not exist before the French Revolution, has, at first slowly but recently far more swiftly, come into being. This is important because it has filled the former vacuum of analytic knowledge as to the difference between a mere constitution and a live political system based on capable people.

As a residue the idea of a role played by one advanced nation in the political development of another "underdeveloped" nation confronts severe impediments. It has been left out of US policy since the emancipation of the Philippines. It would require a wrenching of deep-set attitudes to give it a place again. The only familiar practical application of the idea has been in the case of colonies.

To recapitulate: Assistance or influence by one nation in the politics of another is simply not contemplated by international law and diplomacy. The great and traditional doctrines rest on the firm concept that a state is a state, that any political influence by one on another is through government-to-government relations. Contacts between a government in one state and the parties or popular elements in another is improper, subversive, or generally wrong.

Given the nature of politics, this is quite natural. Any government whatever regards its own relations to its people as private and is apt to react with deep resentment to any intrusion.

These facts being so, there is also a now well-established psychological conditioning of the world press and public opinion adverse to any political interference, tutelage, etc., as "imperialism."

This fact in turn being so, there is a great leverage available to the Communist world to attack any such interference with propaganda with considerable effect.

Finally there are deep-laid attitudes within the US government itself, which are only natural, given the structure of policy and the commitments to it of the men who have been making it and implementing it for decades.

Hence any proposal to introduce a new element in policy and programs aimed directly at political development of "underdeveloped" nations may meet with considerable opposition. There is likely to be both opposition and incredulity.

WHY IS NEGLECT UNDESIRABLE?

The political development of backward nations might be left to the ordinary historical processes and the former historical rate of advance. In short, we can ask: Why not just let nature take its course? There are three major reasons why it cannot be ignored.

First is the population explosion. Modern technology, in general terms, has already affected the reduction of the death rate in formerly primitive peoples to such an extent that the rate of population growth has greatly accelerated. The greatly increased populations of the near-future decades will not be supportable without major changes in agricultural practice including a great trend toward more intensive use of machinery and fertilizer, etc., and much less intensive use of human labor. On the old practices, greater numbers can be employed, or fed, only on a declining standard. The historical pattern of political development would be through a long succession of gradual advance cluttered with wars, civil and foreign, revolutions, dictatorship, failure, and resurgence. One alternative is the one already followed by the USSR and now being followed by China—Communist dictatorship. This provides order under a police state, with fairly rapid progress in technology, the general economy, and basic education.

There is one other measure bearing on the population explosion—birth control. This has been growing in recognition and importance in world opinion, and in some countries, such as India. It offers small promise of cutting off the explosion, however, though it may mitigate it to some minor extent. Even if it does cut down the growth rate, it leaves the problems of cultural, social, and technological advance of the already large population , more than a billion people.

The second major reason why it is unacceptable to "let nature take its course" lies in the situation of the advanced nations. These are tied, or halfway tied, into a condition of mutual deterrence of major war through the development of military nuclear weapons and delivery systems. The extreme scale of destructive power creates very strong motives to maintain stability so as to avoid their use. Such stability, however, also requires that the balance of power in the world should not be radically altered by other means. A general success of Communism in all the underdeveloped nations would destroy the balance of power. The advance of such nations to political maturity without Communism would strengthen the Western position but would not threaten the position of the USSR with an overwhelming coalition of power. The fact is, in any case, that the Communists, both Soviet and Chinese, will make a strong bid for power in the underdeveloped areas, and that the West cannot possibly let this go without an effort to keep all these nations western oriented or at worst neutral.

The status of neutrals is a key fact in the situation. As a bare fact, it proves that a nation progressing quite independently toward a political system that is not Communist in character may be no threat to the Communist Bloc. The balance of power is <u>not</u> disturbed by the neutrality of such powers; it is <u>not</u> disturbed by their continued western orientation; it is disturbed by a Communist take-over; it is disturbed in prospect by the threat of Communist success in any more than isolated cases.

The third reason is that the politically undeveloped areas, comprising at least half the people of the world and half the area and natural resources, are

tied far too intimately to the advanced nations by trade that is essential to both, by geopolitical considerations, ideological factors, and the already vast flow of cultural and technological aid, for simple isolationism to be applied. The processes of political development, if left alone or if left to Communist exploitation, will disturb the advanced Western world in all sorts of ways, and with powerful impact. Initial neglect would only lead later to an active reaction and to escalation of the measures applied.

ARE THERE NEW POSSIBILITIES?

The exclusion of the problem of political assistance without colonial status was natural until recently. If it is reasonable to take a new look at it, this depends on changes in the surrounding conditions and in the available knowledge and interest. These have changed.

The removal of colonialism clears the air. It exposes the problem in its own light. The great number of old and new examples of the lack of political development among now-sovereign nations is large enough to show the common characteristics and eliminate confusion due to special factors. The particular cases are also numerous enough to expose the general effects due to their great aggregate scale. They are even so numerous that they offer examples of how the USSR is faced with dilemmas in trying to deal with them. (As in Syria, where the Russians reportedly find political instability reduces the effectiveness of economic aid.)

In addition a subject on which the literature was very scanty 50 years ago now is much richer in basic materials for study. The time is not long gone when the investigator seeking books closely related to political development could go to de Tocqueville, or to Bryce, or back to Machiavelli and the ancients. Now there is an increasing store of major works with direct or indirect bearing. To mention only a very few, and not only the most recent, and not those most directly concerned but also some broader selection among those that can be taken as highly pertinent, we have the works of Almond,[6] Barnard,[7] Holt,[8] Lawrence,[9] Namier,[10] Pye,[11] Silvert,[12] and Thornburg.[13]

There is also now, as there was not before, a small stock of cases where something has happened that might be described as the take-off phase of political development. One of the best is the case of Magsaysay in the Philippines. Another good one is that of Mexico since the stabilization of the late 1920's. The role of Kemal in Turkey may be another, even if there may be doubts as to whether the momentum attained was enough to keep going. India is another case of relatively superior performance. All still confront severe tests.

Further there is now in social science a great expansion of research as there is in other fields, and the problem of political development is receiving a great deal of attention. Ten years ago there were very few articles on the subject. Now they appear in great numbers and with solid substance derived from research. It is noteworthy that the program of the 1964 meeting of the American Sociological Association was largely concerned with social development, including many papers of close relevance to political development, and recent meetings of the American Political Science Association have given great attention to the problem.

So we may say that the problem has emerged into academic and governmental recognition in recent years. Some very solid work has already been accomplished in the field by social scientists and political scientists. Awareness of it is increasingly expressed by the more serious commentators. So measured, professional interest has increased many times over. The fund of technical and professional knowledge has increased correspondingly. The knowledge, both of how to analyze the problem and how to operate effectively if operations are undertaken, is at least better than ever before.

This increased fund of knowledge has another important characteristic. It is far more analytic, systematic, or scientific in its style, organization, and expression than was formerly the case. Political science before the last quarter century could fairly be described as parochial; the books and the teachers were fairly understandable within their own nation, and the best ones were part of an international scholarly tradition, but they were "all Greek" to outsiders. Anyone could learn descriptive facts about the British form of government, but only the British learned how to run it; the same for American government.

It is recognized among those who study the history or the sociology of science that science is communicated more effectively than knowledge that has not been put into scientific form. This new body of analytic, political, and social science, now growing far more rapidly than was the case even 10 years ago, is more communicable. This is a factor at the center of the situation as regards the problem of exporting political knowledge.

CAN LEGITIMACY BE ESTABLISHED?

The lessons of history are plain. The British, in every instance after the American Revolution, used the initiation of rebellion not as the criterion for immediate independence. Rather they consistently suppressed the first rebellion but also introduced a powerful program of accelerated and orderly progress toward self-government. The British, in cases spread over 120 years, recognized counterinsurgency as essential but also as no solution by itself. It was useful only as the necessary adjunct or preliminary to positive programs toward political development. Lord Durham set his name on the first great case, that of Canada in 1839. Lord Templer set his on the last one, Malaya, in the 1950's. A colonial power in the colonial age had the position from which it could do this. The US is faced with trying to get the same effect in the role of an outsider, with quite a different status in the country concerned, and before the world, and with its own public.

Major doctrines simply cannot be developed in a way contrary to the major facts and the viable assumptions of the time when they arise. The idea that all independent states must keep their hands off the internal politics of each other arose because it made great good sense in the seventeenth and eighteenth centuries. It long since hardened into historical tradition. It still has great merit against subversive activities supported by one government in the territory of another government, for any two governments that recognize each other.

Should it then stand against political assistance of nonsubversive character? The question supposes that nonsubversive political assistance can be a real thing. Or it begs the question: Is there such a thing, or can there be?

This is relevant because any effective program to assist and accelerate political development would surely be challenged as imperialism, colonialism, and further as a breach of right and well-recognized tradition. It would be vulnerable to propaganda attack. If any such program is attempted the US must expect to need the best arguments possible on which to establish that it is, in fact, legitimate.

All questions of legality aside, even the major doctrines of international law are subject to the major changes brought by history. They should not be lightly changed, but neither should they be lightly maintained when the pertinent realities are really different.

All the measures that have been taken by the US Government, and that touch on political development, have been carefully directed to accelerate social development, rather than to touch political development directly. They include the Peace Corps, educational measures, exchange of persons, and "civic action" by US military elements.

To reduce potential opposition, if political development in one country can be helped by policies and measures of another country, it must be with the greatest care for neutrality among all loyal elements in the developing country and for avoidance of any grounds for valid charges of colonialism. And it must be wholly open and aboveboard.

Any measures taken have to be neutral as between an administration in power and any elements properly identified as a "loyal opposition." They must not trespass on the prerogatives of the internal political system to be itself, govern the country, and pursue its own course in national policies and local detail.

Such measures must have objectives of a general nature, clearly and firmly set apart from all immediate issues. The problem is not to tell the natives what decision to make; it is to help them learn to use good decision-making procedures. The objectives are not events or incidents but conditions. These conditions include a much wider spread of self-reliance, of a do-it-yourself attitude, tolerance of diversity, patience in face of the impediments to reform, recognition that reversible actions can be taken with less care for minority views than must be had in the case of irreversible actions, understanding and respect for majority rule on the one hand and for constitutional restraint on the other, and the concept of loyal opposition. Civic socialization has to be extended beyond family and tribe. These things have to be developed at the grass roots and not only in the capital. A developed political system needs strong cadres of people who know how to negotiate debate, and campaign with vigor but without residual destructive antagonism. The fund of experience of these cadres must be gained in local government, labor relations, trade, and education and not just in formal politics.

One specific way in which to provide for legitimacy in the eyes of the country concerned, other countries, or the world in general may be to try to internationalize the program.

Objectives may then conceivably include the following:

(a) Greatly intensified democratic practice in the politics of government and in the politics of economic and social concerns at all levels, from national down to the smallest local level.

(b) More functional associations with more active life, including educational, agricultural, labor, and industrial.

Measures to these ends may conceivably include massive indoctrination in some of the fundamental political lessons of the West. This should begin further back than is commonly supposed. Even such a lesson as might be learned from the career of Frederick the Great, of serving the State rather than the personal fortune of the ruling family, needs to be learned. A first-class job of editing The Federalist to eliminate purely dated or local circumstantial material, and to retain the political principles, might well be distributed by millions. At any rate a main point is a tremendous increase in the information flow concerning the principles of advanced politics in free nations, but with the first thing first: the primer.

IS THE TIME RIPE?

The climate of opinion is not entirely favorable, as was made clear earlier in the discussion of inhibiting factors.

There is, however, rather broad evidence that the climate of ideas has been changing, that new ideas are emerging and beginning to gain acceptance. This is in continuity with the emergence of "economic development" as a concept, propounded most prominently by Rostow about 5 years ago, and the concept of "counterinsurgency" just a little later. The facts mentioned earlier to support the idea that the technical resources are now or soon will be available also imply strongly that the time is ripe in the large-scale historical sense. These are forerunners of the shift of views from those set by the conditions of the late 1940's and early 1950's to the changed condition of the world today.

Comment in the press and other media and in professional journals and books is surely far more sophisticated than it was 15 years ago. There has been, it seems fair to state, increasing recognition that economic and military aid can be ineffective in the absence of a strong political system in the country concerned. There has also been increasing recognition that the "takeoff" stage of economic development is not easy to spark in the absence of suitable political conditions. Congress has expressed itself in a negative fashion, through a tendency to reduce aid appropriations. Surely this is, by implication, a partial withdrawal of credit from the now conventional concept. There is no clear exposition of a new theory available. However, there is a considerable body of work that carries an entirely new attitude toward the problem.

There is also the situation in Vietnam. This has brought a high degree of public concern, and of anxiety at the apparent dilemma presented. For what it is worth, this amounts to a major asset, an opportunity toward fair acceptance of a fresh approach if one can be devised.

The current indications given by the technical journals, the public press, and discussion and concern within the branches of the government imply that the time may be ripe in the short-term sense as well as in the longer view.

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ADDITIONAL REFERENCE

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